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A THEORETICAL EXPOSITION OF EXPORT AND R&D SUBSIDIES

by
BOBBY E. APOSTOLAKIS *

1. *Prologue*

Sovereign governments intervene in trade on a discretionary and *ad hoc* basis by adopting policies they deem appropriate in order to achieve their goals. Apparently, such actions contradict the working rules of global agreements. Export subsidies and surrogate practices, viz. subsidies on research and development (R&D) have been escalated with the growing world antagonism, rising costs, and gradually growing antiquated factories. The main objectives of R&D incentives remain the cost reduction or the increased efficiency in the "laboratory" level. The endorsement of export motives, in the context of an *imperfectly* competitive world, aims primarily at the capturing of a larger share in world markets and the maximization of the domestic welfare.

The analysis of export and R&D incentives has generated a prominent dichotomy in the literature. The supporters of these strategies claim that such motives justify the drain on public resources. Planning for export and R&D subsidies should not be a matter of "either, or" but rather a case of "both, and". Such subsidies should be endorsed to stimulate industrial exports, alleviate balance-of-payments problems, and diversify the economy. R&D subsidies dedicated to the expansion of knowledge can be justified on national and international grounds for the scientific upgrading. Hence, one wonders why some governments are outraged by foreign subsidies? This distortion is anyway the misfortune of the subsidizing nation which benefits

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others who enjoy cheaper foreign products. The chaotic trade experience has recorded some erroneous cases wherein specific governments have protested the subsidization of foreign products which were initially subsidized by them. Straightforward, trade subsidies should be designed in a manner *a*) to avoid discrimination among industries; *b*) revitalize the economy; *c*) satisfy the comparative advantage argument; and *d*) justify the traditional national security, infant industry and import-substitution theories.

Presently, in a theoretical specification, we seek to assess the efficiency of export and R&D subsidies. In view of these widespread intervention schemes, we admittedly abstain from a myriad of other relevant issues. At this point it is pertinent to mention that outright subsidies are rare and henceforth their quantification is notoriously difficult. The paper is organized as follows: In Section 2 we set up a model wherein the home government endorses export and R&D subsidies [1]. In Sections 3 and 4 we analyze some repercussions generated by these subsidies, and in Section 5 we conclude.

2. *Preliminary Analysis*

I. Consider a duopoly between domestic firm 1 and its rival foreign firm 2. Both firms produce a substitute product consumed domestically and abroad. Under non-cooperative comparative statics, these firms determine the level of their R&D in Phase I and decide the output level in a Nash (1950) equilibrium in Phase II. First, by following Spencer and Brander (1983) we analyze Phase II; for firm i ($i = 1, 2$ in superscripts) let:

q = output
C = variable costs, excluding those for R&D
φ = marginal costs
ψ = revenue
δ = R&D level
λ = R&D costs
π = profits
σ, s = export and R&D subsidies, respectively.

[1] Opponents condemn such subsidies and focus on their adverse consequences. Hong (1976) has dealt with the oversubsidization of some inefficient industrial sectors of S. Korea. Islam (1969) studied three schemes of export subsidies in Pakistan. Kostecki (1978, p. 56-78) considered export subsidies only as temporary measures adopted to safeguard the BOP. Hufbauer and Erb (1984) offer a descriptive analysis of export subsidies. Definitions and lists of 12 sorts of export subsidies are cited in Gatt (1979).

We begin with the variable profits π^1 for the domestic firm 1 which are:

$$\pi^1 (q^1, q^2; \delta^1) = \psi^1 (q^1, q^2) - C^1 (q^1; \delta^1) - \lambda^1 \delta^1 \tag{1}$$

where outputs q^1 and q^2 are substitutes and $\psi^1 (q^1, q^2)$ is the world demand for the produced good. Given that output q depends directly on the R&D level δ, then:

$$q^1 = \xi^1 (\delta^1, \delta^2) \qquad \text{and} \qquad q^2 = \xi^2 (\delta^1, \delta^2) \tag{2}$$

If subscripts denote derivatives:

$$\psi^1_2 < 0 \tag{3a}$$

$$\omega^1_{12} < 0 \tag{3b}$$

viz., the variable revenue of firm 1 declines with both an increased output of firm 2 (eq. 3a) and with cross output (eq. 3b).

From the cost point of view, accelerated R&D (δ) raises C at a declining rate as δ increases:

$$C^1_\delta < 0 \qquad \text{and} \qquad C^1_{\delta\delta} > 0 \tag{4a}$$

Also, marginal costs φ ($\equiv \partial\varphi/\partial q$) fall as δ increases:

$$\varphi^1 > 0 \qquad \text{and} \qquad \varphi^1_\delta < 0 \tag{4b}$$

Interestingly, Scherer (1967) based on a theoretical and empirical evidence proved that the cost of R&D is inversely related to time; then R&D costs are increasing and strictly convex in production q. This may be represented by a quadratic funcion of λ:

$$C^1 = \frac{1}{2} \alpha^1 (\lambda^1)^2 \tag{5}$$

where $\alpha^1 > 0$ is inversely related with the cost effectiveness of firm 1's R&D.

The Nash equilibrium in output is characterized by first- and second-order conditions for profit maximization:

$$\pi^1_1 = \psi^1_1 (q^1, q^2) - \varphi^1 (q^1; \delta^1) = 0 \tag{6}$$

$$\pi^1_{11} = \psi^1_{11} - \varphi^1_q < 0 \tag{7}$$

If the own-effects of domestic firm 1 on marginal profits dominate the cross-effects, then:

$$\Delta = \pi^1_{11}\pi^2_{22} - \pi^1_{12}\pi^2_{21} > 0 \tag{8}$$

in order to ensure global stability of the equilibrium.

In conjunction with eq. (8), where $\Delta > 0$, a total differentiation of eq. (6) with respect to q^1 and q^2 yields:

$$\xi^1_1 = \varphi^1_\delta \pi^2_{22}/\Delta > 0 \tag{9}$$

$$\xi^1_2 = -\varphi^1_\delta \pi^2_{21}/\Delta < 0 \tag{10}$$

Hence, the Nash equilibrium output of firm 1 increases with its own R&D (eq. 9) but decreases with the R&D of the foreign rival firm 2 (eq. 10).

II. Hereinafter, we analyze Phase I in which the duopoly determines its own R&D level. Granted that output depends on R&D (eq. 2), profits can be expressed as a function of δ^1 and δ^2. Let π^{*1} be the profit function of domestic firm 1:

$$\pi^{*1} \equiv \pi^1\{\xi^1(\delta^1, \delta^2), \xi^2(\delta^1, \delta^2); \delta^1\} \tag{12}$$

The first-order condition in a Nash equilibrium for R&D is:

$$\pi^{*1}_1 = \pi^1_1\xi^1_1 + \pi^1_2\xi^2_1 - C^1_\delta - \lambda^1 = 0 \tag{13}$$

Since $\pi^1_1 = 0$ (from eq. 6) and $\pi^1_2 = \psi^1_2$, then eq. (13) becomes:

$$\pi^{*1}_1 = \psi^1_2\xi^2_1 - C^1_\delta - \lambda^1 = 0 \tag{14}$$

The second-order condition is:

$$\pi^{*1}_{11} = \psi^1_2\xi^2_{11} + \xi^2_1(d\psi^1_2/d\delta^1) - \varphi^1_\delta\xi^1_1 - C^1_{\delta\delta} < 0 \tag{15}$$

With condition (8) still in order:

$$\Delta^* = \pi^{*1}_{11}\pi^{*2}_{22} - \pi^{*1}_{12}\pi^{*2}_{21} > 0 \tag{8a}$$

viz., the own-effects of firm 1's R&D on marginal profits dominate the cross impacts. Thus, $\pi^{*1}_{12} < 0$ means that an increase in firm 2's R&D will normally reduce the effect of firm 1's R&D on its own (firm 1) profits.

Here, we shall show that the duopoly fails to minimize costs when it applies excess R&D in its production. If the condition for total cost minimization is:

$$C^1_\delta + \lambda = 0 \tag{16}$$

firm 1, owing to eqs. (4a) and (14), sets:

$$C^1_\delta + \lambda = \psi^1_2 \xi^2_1 > 0 \tag{17}$$

which implies that the utilized R&D exceeds the required R&D in the total cost minimization process; hence, there is a bias for excess use of R&D at any level of output.

A comment on eq. (17) is pertinent: Consider that firm 1 is involved with R&D, that firm 2 reacts submissively (i.e. apathetically), and that firm 1 correctly prognoses the reaction of its rival firm 2. If $\bar{C} \geq 0$ are the fixed costs for R&D, a production time-lag $T \geq 0$ is required to complete R&D. The ex ante profits of firm 1 will be $\pi^1_{1,G}$ where G is a random variable. If the R&D is successful, then $G = g$; if the R&D fails (or $\bar{C}$ is excessive), then $G = 1 - g = f$. Finally, assume that firm 2 becomes aware of the random variable G, some t periods ($t \leq T$) after firm 1 undertakes R&D.

Let the expected present value of firm 1 be:

$$V^1 = -\bar{C} + \sum_{T}^{T+t-1} rE(\pi^1_{1,G}) + \sum_{T+t}^{\infty} rE(\pi^1_{1,G}) \tag{18}$$

where r is the discount rate, $1 > r > 0$, and $E(\cdot)$ is the expected value operator. Firm 1 will undertake R&D if and only if:

$$C < \frac{r^{T+t}}{1-r} E(\pi^1_{1,G}) + \frac{r^T - r^{T+t}}{1-r} E(\pi^1_{1,G}) \tag{19}$$

Obviously, firm 1 wishes to face a submissively behaving firm 2; that is:

$$G(1 - r^t)\{\pi^1_{1,g} - \pi^1_{2,g}\} + f\{\pi^1_{1,f} - \pi^1_{2,f}\} > 0 \tag{20}$$

We need to justify eq. (20): Plausibly, $\pi^1_{1,g} > \pi^1_{2,g}$ which means that firm 1 prefers its R&D to succeed rather than fail. If $\pi^1_{1,f} \geq \pi^1_{2,f}$, then condition (20) holds. As $\bar{C}$ increases, firm 1's expected profits increase discontinuously. Hence, *the expected profits of firm 1 owing to R&D are not a monotonic function of the fixed costs $\bar{C}$ for R&D.* Firm 1 might prefer a costly R&D strategy over an inexpensive one since profits grow with increased fixed costs for R&D. This contradicts eq. (17) which is concerned with the overutilization of R&D in the production process of firm 1 [2].

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[2] The analysis of the submissive reaction of firm 2 requires the introduction of subgame strategies. Interestingly, KATZ and SHAPIRO (1987) discuss the post-development dissemination of

3. *R&D Subsidies*

Adoption of R&D subsidies (s) will enable the domestic firm 1 to capture a larger share of the world market and subsequently increase the earnings of its home country. According to eq. (1), the profits of firm 1 after the inclusion of a subsidy (s) per unit of R&D will be:

$$\pi^1 (\delta^1, \delta^2; s) = \psi^1 (q^1, q^2) - C^1 (q^1; \delta^1) - (\lambda^1 - s)\, \delta^1 \tag{21}$$

subject to eq. (2). The first-order condition is:

$$\pi^1_1 (\delta^1, \delta^2; s) = 0 \qquad \text{and} \qquad \pi^2_2 = 0.$$

The total differentiation yields the matrix equation:

$$\begin{bmatrix} \pi^1_{11} & \pi^1_{12} \\ \pi^2_{21} & \pi^2_{22} \end{bmatrix} \begin{bmatrix} \delta^1_s \\ \delta^2_s \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \end{bmatrix} \tag{22}$$

This implies $\delta^1_s = -\pi^2_{22}/\Delta > 0$ since $\Delta > 0$ by eq. (8) and $\pi^2_{22} < 0$ by eq. (15). Also,

$$\delta^2_s = (\pi^2_{21}/\Delta) < 0 \text{ if } \pi^2_{21} < 0 \quad \text{and} \quad \delta^2_s = (\pi^2_{21}/\Delta) > 0 \text{ if } \pi^2_{21} > 0\,^{3}.$$

Thus, *home R&D subsidies will enhance domestic R&D and reduce (increase) foreign R&D provided* $\pi^2_{21} < 0$ ($\pi^2_{21} > 0$).

The optimal R&D subsidy is found at the moment of the net domestic benefit B^1 (i.e., the profits of each domestic firm less subsidy costs) maximization:

$$B^1 (s) = \pi^1 (\delta^1, \delta^2; s) - s\delta^1 \tag{23}$$

The question now is, what the government does by subsidizing R&D that the firm cannot do? The level of R&D chosen by the domestic firm is that which maximizes its profits within the confines of the behavior of the two-stage Nash equilibrium. If a firm violates this equilibrium, it may earn lower profits. Government subsidies may alter the cost structure of a firm and change the set of actions compatible with the two-stage Nash equilibrium which yield higher profits.

R&D. Then the imitating firm 2 benefits and the conventional results in the economics of R&D are abandoned. Bernstein and Nadiri (1989) studied the effects of R&D spillovers and estimated the social and private rates of R&D returns for several industries.

[3] Normally, increases in foreign R&D will reduce the effect of domestic R&D on the profits of firm 1: $\pi^2_{21} < 0$.

From eq. (23) the first-order condition of the welfare maximizing R&D subsidy is:

$$dB^1/ds = \pi^1_1\delta^1_s + \pi^1_2\delta^2_s + \pi^1_s - \delta^1 - s\delta^1_s = 0 \qquad (24)$$

From eq. (21), the partial derivative $\pi^1_s + \delta^1$; from eq. (14), $\pi^{*1} = 0$; since $\delta^2_s = \delta^1_s\,(d\delta^2/d\delta^1)$, then eq. (24) reduces to:

$$dB^1/ds = \{\pi^1_2\,(d\delta^2/d\delta^1) - s\}\,\delta^1_s = 0$$

or:

$$s = \pi^1_2\,(d\delta^2/d\delta^1) \qquad (25)$$

which is the R&D subsidy. Hence, *the optimal domestic R&D subsidy maximizes the profits of firm 1 and reduces the R&D of firm 2*. This is what the government can achieve for the domestic firm that the latter cannot do for itself; if enacted R&D subsidies remain, the firm enjoys higher profits and thus bypasses any price wars.

Although a thorough analysis of duopolistic strategies falls beyond present interests, we briefly examine the reaction of firm 2 when cost effectiveness for R&D favors firm 1 (i.e., α^1 in eq. (5) declines). This situation enhances the present value of firm 1 (eqs. 5 and 11) and decreases the present value of firm 2. If firm 2 reacts submissively to firm 1's lead, it will further lag in R&D and innovation. Unless firm 2 reacts aggressively, firm 1's superiority in R&D will be preserved and even expanded. This will force firm 2 to *retreat* when firm 1's antagonism becomes unrivaled. Then, firm 2 chooses to abstain from the high-tech industry which requires advanced R&D and concentrates in the production of less sophisticated products. It is concluded that *the efficient firm 1 will accelerate innovation. If firm 2 reacts aggressively (submissively) it will perform more (less) R&D*. The present value of the relatively more efficient firm 1 increases if firm 2 behaves submissively; hereafter, firm 1 becomes the technological leader.

4. *Export Subsidies*

The government, now, enacts both R&D and export subsidies (σ) before R&D is actually applied. Thus, export subsidies affect both the choice of output and R&D directly. Then, the profit function of firm 1 becomes:

$$\pi^1(\delta^1, \delta^2; s, \sigma) = \psi^1(q^1, q^2) - \varphi^1(q^1; \delta^1) + \sigma q^1 - (\lambda^1 - s)\,\delta^1 \quad (26)$$

where:

$$q^1 = \xi^1(\delta^1, \delta^2; \sigma), \qquad q^2 = \xi^2(\delta^1, \delta^2; \sigma)$$

and both δ^1 and δ^2 depend on σ and s. Also, the benefit function becomes:

$$B^1(s, \sigma) = \pi^1(\delta^1, \delta^2; s, \sigma) - \sigma q^1 - s\delta^1 \quad (27)$$

Taking the derivative of B^1 with respect to s and solving for s yields [4]

$$s = \pi^1_2(d\delta^2/d\delta^1) - \sigma(dq^1/d\delta^1) \quad (28)$$

If $\sigma = 0$, eq. (28) coincides with eq. (25) which represents the R&D subsidies. With the presence of σ, though, s is reduced by the positive term $\sigma(dq^1/d\delta^1)$. Hence, *with the adoption of export subsidies, R.&D subsidies deteriorate.*

The first-order condition of eq. (27) with respect to export subsidies σ is:

$$\sigma = (\pi^1_2\delta^2_\sigma + \psi^1_2\xi^2_\sigma)/(dq^1/d\sigma) - \{s\delta^1_\sigma/(dq^1/d\sigma)\} \quad (29)$$

Solving eqs. (28) and (29) together yields:

$$s = -\psi^1_2\xi^2_1 < 0 \quad (30)$$

and

$$\sigma = \{\pi^1_2(d\delta^2/d\delta^1) + \psi^1_2\xi^2_1\}/(dq^1/d\delta^1) > 0 \quad (31)$$

Thus, *increased export subsidies for the products of firm 1 enhance its own output and reduce the production of foreign firm 2. The optimum export subsidies σ are positive (eq. 31) but the optimal R&D subsidy s, in the presence of export subsidies, is negative (eq. 30).* This suggests that *firms enjoying subsidies should not adopt R&D subsidies. The government should subsidize a firm's R&D when export subsidies are absent.* Yet, one should keep in mind the problem of R&D overutilization.

When firm 1 accepts export subsidies – after the application of R&D – it maximizes profits as:

$$\pi^1(\delta^1, \delta^2; \sigma) = \psi^1(q^1, q^2) - \varphi^1(q^1; \delta^1) + \sigma\delta^1 \quad (32)$$

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[4] Its arithmetic derivation is available on request.

Using Cramer's rule, as in eq. (22), yields:

$$q^1_\sigma \equiv dq^1/d\sigma = -\,\pi^2_{22}/\Delta > 0 \qquad (33)$$

$$q^2_\sigma \equiv dq^2/d\sigma = \pi^2_{21}/\Delta < 0 \qquad (34)$$

where Δ has been shown in eq. (8). Since $q^1_\sigma > 0$, an increase in export subsidies enhances domestic exports given that $\pi^2_{22} < 0$ from eq. (7) and $\Delta > 0$ from eq. (8). Also, domestic export subsidies depress the output of the foreign firm (eq. 34).

The comparative static effects of export subsidies in firm 1 are summarized below:

i) *Drop the world price of the subsidized product*:

Proof: If total revenue is $\psi^1 = \rho^1 q^1$, then the change in price (ρ) is equal to the slope of the inverse demand times the change in total quantity:

$$d\rho^1/d\sigma = \rho^1\,(q^1_\sigma + q^2_\sigma) = \rho^1\,(\pi^2_{21} - \pi^2_{22})/\Delta < 0 \qquad (35)$$

since price $\rho > 0$, $\pi^2_{21} < 0$ (ft. 3), $\pi^2_{22} < 0$ (eq. 15), and $\Delta > 0$ (eq. 8).

ii) *Increase domestic profits:*

Proof: From the total differentiation of π^1 with respect to σ:

$$d\pi^1/d\sigma = \pi^1 q^1_\sigma + \pi^2 q^2_\sigma + \partial\pi^1/\partial\sigma \qquad (36)$$

Since $\pi^1 = 0$ (eq. 6), $\partial\pi^1/\partial\sigma = \delta^1$ (eq. 32), and $q^2_\sigma < 0$ (eq. 34), then eq. (36) is positive.

iii) *Depress foreign profits:*

Proof: Along the same lines:

$$d\pi^2/d\sigma = \pi^2_1 q^1_\sigma + \pi^2_2 q^2_\sigma < 0 \qquad (37)$$

iv) *Enhance the domestic net welfare:*

Proof: Rewrite eq. (27) as:

$$B^1\,(\sigma) = \pi^1\,(\delta^1, \delta^2; \sigma) - \sigma q^1 \qquad (38)$$

The derivation of eq. (38) with respect to σ yields:

$$dB^1/d\sigma = \pi^1_\sigma - q^1 - \sigma q^1_\sigma = q^1\rho^1 q^2_\sigma - \sigma q^1_\sigma \qquad (39)$$

due to eq. (36). Setting $dB^1/d\sigma = 0$ yields:

$$\sigma = q^1 p^1 \delta_\sigma^2 / q_\sigma^1 > 0 \tag{40}$$

that is, a marginal increase in the export subsidies of the products of domestic firm 1 improves the home welfare.

5. *Epilogue*

Nationalism and credibility, deficits and debts, devaluations and terms of trade are indicative arguments used by central governments to openly intervene in trade despite of their international commitments. Presently, under a duopoly of a substitute good produced in two countries and exported to the rest of the world, we established some non-cooperative comparative statics. We mainly showed the repercussions generated by the subsidization of the home exports and R&D.

The theoretical findings are:

R&D Subsidies:

i. Yield a dubious result concerning the over-utilization of R&D in production. It is stated that a) expected profits from R&D are not a monotonic function of fixed costs for R&D, and b) profits grow with increased fixed costs for R&D.

ii. Enhance domestic R&D and profits; domestic R&D subsidies reduce foreign R&D.

iii. Increase domestic innovation in the presence of cost-effectiveness in the domestic R&D. Whether firm 2 performs more (less) R&D depends on its aggressive (submissive) reaction.

Export Subsidies:

i. Reduce its own (domestic firm 1) R&D subsidies.

ii. Increase domestic output, profits, and welfare; depress the output and profits of rival firm 2.

iii. Are preferred to the domestic R&D subsidies.

iv. Depress the world price of the subsidized good.

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ESPOSIZIONE TEORICA DEI SUSSIDI ALL'ESPORTAZIONE E ALLA RICERCA E SVILUPPO

In un contesto teorico di un duopolio con due paesi, vengono esaminate alcune ripercussioni dei sussidi all'esportazione e alla ricerca e sviluppo su una impresa nazionale. In particolare, vengono determinate le variazioni della ricerca e sviluppo, della produzione e dei profitti di entrambe le imprese. Vengono anche esaminati i cambiamenti di benessere, dovuti ai sussidi nel paese che li offre. Gli effetti dei sussidi alla ricerca e sviluppo sono studiati separatamente da quelli dei sussidi all'esportazione. Questi effetti differiscono per ragioni evidenti.

Il successo dei sussidi nazionali alla ricerca e sviluppo dipende, ceteris paribus, da se l'impresa rivale reagisce in modo aggressivo o no. Inoltre, gli effetti di statica comparata dei sussidi all'esportazione si concentrano sul prezzo mondiale del prodotto sussidiato, sui profitti nazionali ed esteri e sul benessere netto nazionale. Nel complesso, l'impresa nazionale preferisce sussidi all'esportazione a sussidi alla ricerca e sviluppo.

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ESPOSIZIONE TEORICA DEI SUSSIDI ALL'ESPORTAZIONE E ALLA RICERCA E SVILUPPO

In un contesto teorico di un duopolio con due paesi, vengono esaminate alcune ripercussioni dei sussidi all'esportazione e alla ricerca e sviluppo su una impresa nazionale. In particolare, vengono determinate le variazioni della ricerca e sviluppo, della produzione e dei profitti di entrambe le imprese. Vengono anche esaminati i cambiamenti di benessere, dovuti ai sussidi nel paese che li offre. Gli effetti dei sussidi alla ricerca e sviluppo sono studiati separatamente da quelli dei sussidi all'esportazione. Questi effetti differiscono per ragioni evidenti.

Il successo dei sussidi nazionali alla ricerca e sviluppo dipende, ceteris paribus, da se l'impresa rivale reagisce in modo aggressivo o no. Inoltre, gli effetti di statica comparata dei sussidi all'esportazione si concentrano sul prezzo mondiale del prodotto sussidiato, sui profitti nazionali ed esteri e sul benessere netto nazionale. Nel complesso, l'impresa nazionale preferisce sussidi all'esportazione a sussidi alla ricerca e sviluppo.

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UNE ANALYSE INTERPRÉTATIVE DU MODÈLE CYCLIQUE DE FANNO

par
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« Les facteurs extérieurs qui conditionnent existent toujours dans le sens qu'il y a dans chaque situation, selon toute probabilité, un niveau *maximum* du taux de l'épargne, un niveau *maximum* d'augmentation de la population ou un flux *maximum* de nouvelles idées, pouvant chacun d'entre eux être atteint. Mais le fait est que les valeurs *effectives* de ces variables, dans une société et à une époque données, ne sont pas déterminées par leurs valeurs maximales théoriques, mais peuvent etre ralenties ou accélérées suivant le comportement des chefs d'entreprise susceptibles d'exercer une poussée en avant ou en arrière » (Kaldor, 1984, p. 92).

1. *Introduction*

Le sujet abordé par Fanno fait depuis longtemps l'objet de nombreuses études et de recherches qui présentent le plus souvent un caractère unilatéral, car elles tendent à privilégier un seul aspect de cette problématique si complexe. Si l'Auteur se réfère aux analyses et aux réflexions les plus significatives, ce n'est certes pas pour accorder à ces théories une position

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J'adresse toute ma reconnaissance à Madame ML. Manfredini Gasparetto, élève de Marco Fanno, qui a bien voulu aborder quelques thèmes de la pensée du grand économiste et m'a permis de consulter de nombreux ouvrages de sa vaste bibliothèque, aujourd'hui difficiles à trouver. Il va sans dire que cet article n'engage que ma propre responsabilité.

dominante, mais bien pour les insérer dans le cadre de son schéma théorique, lequel, résultant d'une plus grande ampleur, assume une dimension générale. On retrouve constamment chez Fanno cette volonté de dépasser les étroites limites conceptuelles d'un système interprétatif rigide, comme nous l'avons déjà souligné à propos de son analyse sur le cours des changes (Nardi Spiller, 1992).

L'approche spéculative qui en dérive, présente des « points de contact » avec d'autres théories: Fanno lui-même le reconnît dans sa *Prefazione* (1947, p. XII). D'où les références possibles aux analyses de Keynes (1930, 1936) et de Schumpeter (1912, 1928, 1939) pour les rapports qui en découlent, respectivement, quant au déséquilibre entre épargne et investissement, et à l'impact des innovations techniques sur le système économique; encore que ces dernières puissent expliquer les fluctuations de longue durée de Kondratieff (1926), mais non les fluctuations ordinaires (Fanno, 1956, p. 406). L'interprétation de Pigou (1927) est sensible là où les impulsions originelles des fluctuations sont ramenées à de nombreuses motivations, quoique Fanno aborde et envisage le problème d'une tout autre façon. On relève encore des éléments communs à l'oeuvre de Mitchell (1927) qui discerne, dans les variations enregistrables du niveau des profits, les facteurs les plus immédiats et directs des changements de conjoncture, et considère, par ailleurs, le facteur monétaire et bancaire comme un élément passif pendant les phases des oscillations, excepté dans la période de transition entre une conjoncture favorable et une conjoncture défavorable. Des éléments de parenté se retrouvent également dans la structure doctrinale de Fisher (1932), à propos des endettements excessifs, et dans l'apport de Robertson (1915), quant à l'importance du renouvellement périodique des équipements industriels. L'on ne saurait encore oublier Aftalion (1913), là où ce dernier souligne le relief que prend dans les mouvements cycliques la différence entre le volume de capitaux dont la production est entreprise à un moment donné et l'activité nécessaire pour compléter les capitaux, dont la production commence par contre précédemment. Par ailleurs, dès 1912, Fanno greffe et coordonne sur sa propre théorie des cycles économiques, en tant que partie intégrante, la théorie wicksellienne « des relations entre prix, escompte et intérêt (profits) » (Manfredini Gasparetto, 1984, p. 240).

Il n'en demeure pas moins, rappelons-le, que le schéma interprétatif de Fanno a une identité bien spécifique, centrée sur le rôle des profits « animateurs » des mouvements auxquels les économies sont sujettes et sur le principe-base des écarts de temps [1], dérivant de la durée des processus

[1] Les écarts de temps ne sont de toute façon pas les seuls susceptibles d'être commis. Il

productifs et relevables dans la stimulation des fluctuations. Nous nous proposons ici, de dégager la valeur de l'apport de notre Auteur, que nous présenterons schématiquement, et de mettre en évidence les projections potentielles de sa pensée dans le cadre de la réalité économique actuelle.

2. *Le modèle combinatoire cyclo-trend de Fanno*

Dans l'optique de Fanno, le modèle concentré sur l'hypothèse de *trend* stationnaire n'est pas réaliste, étant donné que seuls les modèles combinant le cycle et le développement d'une longue période rendent plausible une interprétation du phénomène en cours, bien que les transpositions virtuelles puissent éveiller une certaine perplexité, si l'on sait que

> « Le trend est calculé sur la base d'observations tirées du passé; il appartient au passé, et c'est vraiment un acte de foi que de supposer que le passé est encore significatif. Un acte de foi d'autant plus contraignant que la période sur laquelle se calcule le trend est de longue durée » (Hicks, 1982, p. 334).

Si l'on considère le schéma conceptuel de l'Auteur italien, basé sur la dynamique d'expansion [2] qui caractérise les systèmes capitalistes, où l'investissement dépend pour la plupart des décisions des chefs d'entreprise privée, il est possible de tracer trois courbes fondamentales, soit, respectivement, la ligne de l'expansion potentielle, la ligne de l'expansion séculaire et la ligne de l'expansion effective.

> « C'est à l'intérieur de ce schéma défini par ces trois courbes, que se déroule le processus d'expansion des systèmes et que se développe par là la tendance de ces derniers à fluctuer » (Fanno, 1956, p. 354).

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est également possible de commettre des écarts de qualité, de quantité et de coût (FANNO, 1947, chap. III et chap. XI). L'on commet des écarts de qualité lorsque l'on produit des biens qui ne correspondent pas aux goûts des consommateurs (c'est le cas des biens directs) ou aux nécessités technico-économiques des producteurs (cas des biens-capitaux). Les écarts de quantité adviennent chaque fois que le volume de production est inférieur ou supérieur au volume de la marchandise vendue au prix de revient. Enfin, les écarts de coût s'observent lorsque, entreprenant une activité productive de certains biens et prévoyant certains coûts, ceux-ci se révèlent par la suite tellement supérieurs que le maintien de la production paraît « désastreux » (FANNO, 1947, pp. 297-298 et 1956, pp. 311-312).

[2] SCHNEIDER (1966) précise parfaitement la différence qui sépare, dans l'analyse de Fanno, l'expansion de la croissance. La première caractérise la longue période, puisque c'est un processus d'augmentation des biens d'équipement et de la capacité productive des systèmes, alors que la seconde intéresse la courte durée.

Les rapports existant entre ces trois courbes ne sont ni immédiats ni faciles, d'autant plus que le modèle de Fanno n'a pas un aspect formel; aussi est-il nécessaire, comme le soutient Marrama (1974, p. 225 et p. 228), de procéder, du moins à certains moments du traité, à une interprétation de la pensée de l'Auteur.

L'expansion potentielle d'un système économique est liée à trois facteurs: la croissance de la population, les progrès techniques de la production et la tendance du public à l'épargne. Toutefois, ces facteurs ne sont pas en mesure, seuls, de déterminer le processus d'expansion. Ils expriment seulement la possibilité de créer un revenu dans la mesure où sont pleinement utilisées les ressources disponibles. En somme, nous avons là une figure anticipée du *ceiling* hicksien (voir Fig. 1, en échelle semi-logarithmique).

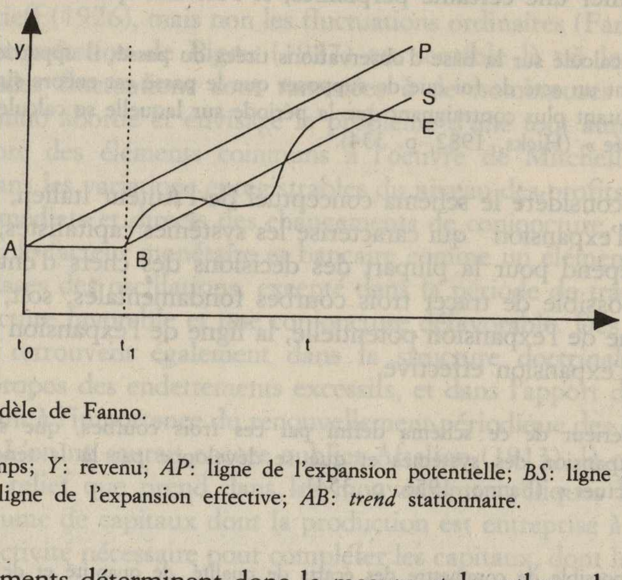

FIG. 1: Le modèle de Fanno.

Légende: *t*: temps; *Y*: revenu; *AP*: ligne de l'expansion potentielle; *BS*: ligne de l'expansion séculaire; *BE*: ligne de l'expansion effective; *AB*: *trend* stationnaire.

Ces éléments déterminent donc la mesure et le rythme de l'expansion potentielle qui devient réelle quand les entreprises réalisent de nouveaux investissements, lesquels, à leur tour, sont étroitement liés à la faisabilité d'obtenir, à la suite de leur réalisation, des profits suffisamment rémunérateurs. C'est alors que démarre, en retard par rapport à la ligne de l'expansion potentielle, la ligne de l'expansion séculaire qui avance ensuite sans interruption, puisque

« la tendance des investissements privés à diminuer, au fur et à mesure qu'ils sont réalisés, la distance entre développement réel et développement potentiel, et la chute des profits qui s'ensuit, est continuellement compensée par la tendance opposée, dérivant du cours ascendant de la ligne de l'expansion potentielle » (Marrama, 1974, p. 226).

Ce qui caractérise le plus la ligne de l'expansion séculaire, c'est qu'elle est parallèle à celle de l'expansion potentielle, mais il ne pourrait pas en être autrement.

« En effet, si la première avait une inclinaison supérieure à la seconde sur l'axe des abscisses, la distance entre les deux droites tendrait à diminuer, ce qui signifierait que le profit minimum tombe en-dessous du niveau à partir duquel sont entrepris de nouveaux investissements. Ces derniers seraient donc réduits jusqu'au moment où, grâce au cours croissant de l'expansion potentielle, serait rétablie la distance entre cette dernière et la ligne de l'expansion séculaire. Vice versa, si cette ligne avait une inclinaison inférieure sur l'abscisse à la ligne de l'expansion potentielle, la distance entre les deux droites tendrait à augmenter, ce qui entraînerait des perspectives de profits plus rémunérateurs et une hausse consécutive des investissements » (Marrama, 1974, pp. 226-227).

C'est ainsi que se constituent les profits de développement (*profitti di sviluppo*), soit, sur la Fig. 1, la distance *AP-BS*.

D'un point de vue formel, la droite *BS* est semblable à la droite qui, dans l'analyse de Hicks (1950) marque le mouvement du *trend* que suit le système économique au cours d'une longue période, quoiqu'elle présente une différence importante. En effet, chez Hicks [3], ce sont les investissements autonomes qui jouent le rôle principal, tandis que chez Fanno, la *BS* est reliée à tous les investissements, quels qu'ils soient, que la croissance de la ligne de l'expansion potentielle rend peu à peu profitables [4]. Toutefois, loin d'être stable et infinitésimal, le volume des investissements apparaît irrégulier, ce qui entraîne des rectifications au niveau du revenu, de la consommation, de l'épargne. C'est ainsi que naissent les profits de conjoncture (*profitti congiunturali*), réalisables quand les variations de salaire et, d'une façon générale, toutes ces variations virtuelles qui perturbent les coûts des différents *inputs*, se produisent en retard par rapport aux changements des prix concernant la sphère de production.

Fanno, qui a finement observé les liens unissant le cours des salaires et la dynamique des prix, estime que

« 1) au début des phases ascendantes, ils [les salaires] restent stationnaires ou presque, tandis que les prix ont déjà commencé à augmenter; 2) par la suite, quand la phase

[3] Il est surprenant de constater que Hicks ne cite point Fanno, alors que les recherches de ce dernier sont précisément antérieures.

[4] FANNO (1933) analyse une situation où le système « reste embrouillé » dans une phase de récession. Cf. à ce sujet le commentaire de MAGLIULO (1992).

ascendante est achevée, les prix et les salaires augmentent simultanément; 3) au début des phases décroissantes, les salaires conservent les positions atteintes, tandis que les prix commencent déjà à baisser; 4) finalement, au terme de cette phase décroissante, les salaires et les prix finissent par diminuer simultanément » (Fanno, 1947, p. 164).

De ces considérations découlent des modifications substantielles sur le niveau de la consommation [5] et des profits, et, par conséquent, le processus cumulatif même qui régit l'ensemble du système se trouve altéré.

A travers l'analyse de Fanno sur la dynamique des prix, on peut saisir la pensée dominante de l'époque, où le rôle de l'inflation due aux salaires apparaît modeste. Par ailleurs, c'est le déclenchement de la guerre de Corée, au début des années 50, qui impose l'importance de la dynamique inflationnelle due aux coûts, avec toutes ses variantes les plus significatives qui prennent peu à peu une consistance spécifique, en fonction de l'impact qu'elles exercent sur la réalité économique.

3. *Fluctuations économiques et croissance*

Les fluctuations caractérisent les processus de croissance, mais, contrairement aux études de Marx et de Schumpeter, la plupart des traités économiques étudient séparément les deux phénomènes. Le motif fondamental de cette dissociation entre cycle et *trend* doit eître attribué en bonne part aux difficultés d'analyse, variables selon le type d'approche adoptée, que révèle le fait d'aborder conjointement une telle problématique. En effet, les mouvements de croissance ont une vitesse relativement faible, mais ils suivent le même cours et acquièrent du relief sur une longue durée; tandis que les mouvements qui marquent les cycles de périodicité, présentent une vitesse souvent beaucoup plus élevée, quoique leurs cours révèlent tout aussi rapidement de virtuelles inversions.

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[5] Fanno (1956, chap. III) analyse dans le cadre d'une économie stationnaire, l'effet d'une perturbation *una tantum* qui frappe les consommations. L'enquête est menée à partir d'une activité productive des entreprises calculée en journées de travail, c'est-à-dire fondée sur des matières premières et des semi-produits qui, à travers des étapes successives, subissent les transformations de rigueur pour devenir des produits à placer sur le marché. Mais ce schéma n'est pas suivi dans les chapitres suivants, lesquels sont centrés sur les économies progressives où la notion de temps nécessaire à la production est simplement exprimée au moyen d'un *lag*. Cela sous-entend l'adoption implicite d'une seule phase de travail. « Par ailleurs, les théories des cycles économiques considèrent le plus souvent le retard et négligent l'analyse temporelle du processus de production » (Montesano, 1982, p. 217). Toutefois, on peut relever des variations de la vitesse de production telles que se trouve enclenché un comportement appréciable dans certaines situations particulières, observables du cycle économique, comme l'a souligné avec acuité Montesano (1982).

Le modèle de Fanno, tout comme celui de Hicks, appartient au groupe des modèles combinatoires cyclo-*trend*. Chez Fanno, la ligne de l'expansion potentielle décrit l'évolution de l'économie dans des conditions d'équilibre et de totale occupation des facteurs productifs.

Cette ligne est, en somme,

« le lieu géométrique des positions successives des équilibres walras-parétiens d'un système en cours d'expansion, et donc la ligne où en chaque point, donc tout au long de laquelle, les entreprises ne réalisent pas de gains ni ne subissent de pertes » (Fanno, 1956, p. 44).

Il s'ensuit que,

« l'investissement manquant des stimulants nécessaires, le système économique ne peut pas suivre concrètement ce mouvement » (Cozzi, 1982, p. 228).

Dans ce schéma conceptuel, la ligne de l'expansion séculaire [6] se justifie pleinement, puisqu'elle décrit comment se comporte le système économique quand les chefs d'entreprise perçoivent un profit satisfaisant, capable à la fois de légitimer les décisions passées et de stimuler de nouvelles initiatives. En effet, on peut remarquer

« que le profit exerce une fonction fondamentale dans les économies capitalistes et à quel point les variations en cours, et mieux encore en perspective, tendent, selon la direction présumée, à accélérer ou à retarder l'activité » (Fanno, 1947, p. 103; concept fondamental, repris évidemment dans l'édition de 1956, p. 119).

C'est de là que part l'analyse de Fanno sur les rapports prix-profits et profits-volume de la production globale (1947, chap. V et chap. VI; en particulier le chap. VI dans l'édition de 1956), à tel point que l'Auteur en arrive à considérer les variations présumées des profits non pas comme le résultat final mais bien comme la cause qui détermine les modifications des autres facteurs. Par conséquent, les changements qui interviennent dans le niveau des profits

« s'affirment, en tant qu'objet de prévision, comme un élément actif, et non passif, des fluctuations » (Fanno, 1947, p. 147).

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[6] Le *warrented path of growth* et le *natural path of growth*, analysés par HARROD (1948), présentent de points de contact avec les lignes de l'expansion potentielle et séculaire, comme Fanno lui-même le précise dans l'édition revue et corrigée de son essai (FANNO, 1956, n. 1, p. 51 et n. 1, pp. 58-59).

Par ailleurs

« les prévisions sur les variations des profits qui, considérées en elles-mêmes, figurent comme des forces motrices originelles, apparaissent comme une résultante » (Idem, p. 149)

des facteurs propulsifs et perturbants, mais, en même temps, elles représentent

« le moyen par lequel l'action mécanique de ces facteurs, se transformant en force humaine en action, communique le mouvement à tout le système » (Idem, p. 149).

Fanno renforce sa pensée dans l'édition suivante de son oeuvre, où il affirme que l'introduction du multiplicateur et de l'accélérateur [7]

« n'empêche pas de continuer à considérer les profits, tels qu'ils sont effectivement dans les économies capitalistes, à savoir les éléments moteurs des mouvements auxquels ces dernières sont assujetties » (Fanno, 1956, p. 179).

Se détachant ouvertement de l'analyse de Harrod, Fanno soutient dans son taux sur le profit attendu [8] en tant qu'anneau de conjonction, la liaison entre les lignes de l'expansion séculaire et potentielle, réalisable à travers la fonction d'investissement.

Cette connexion est d'une importance capitale puisque Fanno cherche, en posant ainsi le problème, à surmonter les ambiguïtés qui peuvent dériver d'une approche basée sur l'action réciproque du multiplicateur et de l'accélérateur, vu que, dans ce dernier cas, c'est précisément en fonction de la valeur qu'ils prennent que les coefficients impriment ou non un mouvement cyclique à l'activité économique.

Dans le schéma théorique de Fanno, il est de la plus haute importance que la prévision soit concentrée sur le cours des profits, ce qui renvoie à l'efficacité marginale du capital, étant donné que les prévisions des entreprises finissent par constituer le pivot où se jouent les décisions qui se répercuteront sur les investissements à faire. En effet,

« Les variations des profits présents et futurs, considérées... comme facteurs déter-

[7] En ce qui concerne ce mécanisme, l'essai de SAMUELSON (1939) marque une étape capitale.

[8] Le taux de profit attendu influence directement les décisions relatives aux investissements primaires et influe aussi, indirectement, sur la réalisation des investissements secondaires et tertiaires.

minant les variations de conjoncture, s'identifient pratiquement avec les variations de l'efficacité marginale du capital de Keynes (*The General theory of employment, interest and money*, London, 1936, p. 316 et sv.). Par conséquent, les deux théories, celle de Keynes et la nôtre, se correspondent en substance sur ce point » (Fanno, 1956, p. 355, n. 1).

Il en découle que

« la fonction, que l'économie keynésienne attribue à l'efficacité du capital, appartient chez Fanno au profit, qui dans les économies progressives sert d'incitation à investir chaque fois que le développement effectif des systèmes, en retard sur le potentiel, offre une marge rémunératrice suffisante aux investissements » (Manfredini, 1969, p. 139).

L'interprétation dynamique du processus productif [9], qui se concrétise dans des augmentations de revenu, ne peut de toute façon pas être dissociée de la fonction du chef d'entreprise. En effet, c'est par rapport au développement que doivent être réalisées de nouveaux biens d'équipement, dont l'exécution dépend strictement des bénéfices obtenus, lesquels font partie par ailleurs des estimations des chefs d'entreprise. Il en dérive un rapport étroit entre la réalisation virtuelle de profits et le cours de l'activité économique. Aussi le raisonnement analytique de Fanno débouche-t-il sur une théorie globale de l'expansion des systèmes, offrant également une interprétation dynamique de longue période à l'analyse keynésienne.

4. *Mouvements conjoncturels et chocs perturbant le systeme économique*

Au cours de ce siècle, l'activité productive des économies capitalistes, quoique marquée par d'amples oscillations, traverse dans les années 1950-1970 une phase d'expansion sans précédent, tant pour la durée que pour l'ampleur et la continuité du rythme de croissance productive. Par conséquent, les mouvements du cycle résultent mitigés, bien que dans l'intervalle entre 1973 et 1975 se dessine une situation tout à fait particulière qui

[9] Pour Fanno, un système économique est stationnaire quand sa structure et ses dimensions restent constantes au fur et à mesure que le temps s'écoule, à la différence d'un système statique où la structure et les dimensions demeurent inchangées et au système progressif où elles tendent à augmenter. Pour l'Auteur, les configurations de l'équilibre général ne peuvent pas être utilisées pour l'étude des fluctuations. La Volpe (1952, p. 607), tout en reconnaissant que la théorie walras-parétienne néglige des aspects fondamentaux dans l'explication des oscillations, admet sa validité dans les configurations des systèmes. Fanno ne partage pas cet avis (1952, p. 533), estimant qu'il s'agit de fluctuations différentes de celles que les systèmes économiques enregistrent concrètement.

se reproduira d'ailleurs au début des années 80. La nouveauté du phénomène réside dans une conjonction singulière: le ralentissement de la croissance et la montée des prix, en présence d'un taux de chômage en hausse [10].

Les effets déséquilibrants sur l'état économique peuvent généralement être recherchés parmi les fluctuations des investissements, les variations de la dépense publique, les modifications de la consommation privée, l'apparition d'impasses d'origine extérieure, dont l'importance est considérable; tout ceci influe négativement sur le domaine de la production nationale. Dans ce contexte, les mesures de politique monétaire et fiscale qui sont adoptées, sont destinées à vanifier ou à modérer la fréquence, l'intensité et la durée des perturbations relatives; mais il se peut tout aussi bien qu'elles paraissent elles-mêmes inadaptées et qu'elles exercent par là même une influence négative non négligeable sur la dépense globale. Aussi, faisant face à une situation de *stagflation*, plus aisément identifiée dans la problématique affrontée récemment par les économies, les stratégies adoptées peuvent elles-mêmes entraîner une forte augmentation du chômage, et agraver les troubles en cours du système économique [11]. Dans une phase de récession ou de stagnation, alors que la capacité productive est en excédent par rapport à la demande correspondante, le rôle fondamental des interventions de l'état se confirme à condition que le soutien apporté au système, n'engendre pas une nouvelle capacité productive et soit en même temps capable de dissiper les conditions actuelles d'incertitude, afin de ranimer l'activité économique.

Dans un cadre si complexe, l'on ne saurait se limiter aux seules conditions centrées sur le capital fixe, puisque l'utilisation qu'on en fait apparaît souvent retardée, à cause, entre autres, de *lags* portant sur des investissements complémentaires ou même concernant la réalisation manquée de structures de support appropriées.

D'autre part, si les causes qui influent sur l'activité économique sont diverses, il n'en est pas moins vrai que les facteurs qui déterminent les investissements ne perdent pas leur valeur. Les chocs responsables de l'augmentation ou de la diminution du revenu et de l'emploi, agissent tant sur la demande que sur l'offre. De toutes façons, les nouvelles conditions potentielles du système ne peuvent demeurer opérantes si une situation de stabilité

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[10] C'est ainsi que se dégage la contexture de stagnation économique et d'inflation, ou, autrement dit, prend forme la *stagflation*. L'insolite dynamique inflationniste impose la recherche d'une approche théorique adéquate, d'autant plus que cette situation articulée peut déboucher sur des états de *unempflation* et de *slumpflation*. Cf. à ce sujet l'analyse de NARDI SPILLER (1990).

[11] Les décisions prises dans le cadre d'une politique de restriction peuvent stimuler, comme cela advint au lendemain du premier choc pétrolier, la croissance du taux de chômage.

n'est pas établie. En effet, ce sont les perspectives favorables qui permettent d'estimer la possibilité d'obtenir des marges de profit et donc de stimuler les investissements. L'octroi de taux d'intérêt séduisants tout comme les divers dégrèvements fiscaux ne peuvent à eux seuls relancer l'activité des entreprises. Comme l'avaient déjà souligné les Physiocrates et Smith, les mécanismes, opérant dans la société, découlent des comportements adoptés par les opérateurs qui recherchent leur propre intérêt. Mais c'est fondamentalement l'état de confiance [12] perçu par les chefs d'entreprise, qui est à la base du dynamisme du système économique et qui, rendant possible la réalisation des investissements, confirme le rôle des *animal spirits*.

5. *Conclusion*

Dans l'étude de Fanno, comme d'ailleurs chez Hicks, le système peut ne pas atteindre les limites supérieure et inférieure au cours de la fluctuation, pour des phénomènes d'étranglement et à cause de consistantes innovations technologiques qui, même dans une phase de conjoncture négative, peuvent stimuler des investissements. Entre les deux limites extrêmes, se situe une multitude de situations intermédiaires, toutes caractérisées par une particularité bien spécifique.

Il est tout aussi surprenant que regrettable que l'analyse de Fanno soit le plus souvent négligée, et que soit ainsi dépréciée l'acuité de son apport spéculatif et opérationnel. A travers la relation entre l'expansion séculaire et l'expansion potentielle, l'Auteur italien cherche à surmonter les difficultés dérivant d'un modèle fondé sur l'interaction du multiplicateur et de l'accélérateur. Par ailleurs, l'on ne saurait nier que la structure de Hicks introduit la possibilité d'un développement cyclique, liée aux investissements autonomes. Toutefois, l'absence d'explication quant à la croissance temporelle d'une telle typologie d'investissements, ne laisse de susciter une certaine perplexité. Dans la charpente conceptuelle de Fanno, l'élément crucial, tout en faisant appel au cours exogène de la potentialité de croissance, devient le substrat aux motivations économiques, en tant que base du processus de décision, déterminant la réalisation des investissements.

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[12] Le climat d'incertitude qui se propage dans une nation, alimenté par la crainte d'une dévaluation ou de changements d'ordre politique, peut entraîner des fuites de capitaux. Dans notre Pays, la quantité massive de ces exodes, tant dans les années 60 que 70, influe lourdement sur l'ensemble de l'activité économique. Les motivations qui déclenchent ces flux « anormaux » de capitaux et les problématiques qui en dérivent font l'objet de la part de FANNO (1935) d'une analyse d'une nouveauté absolue.

D'où l'importance de l'interprétation de l'Auteur italien qui met l'accent sur le « gain » virtuel, générateur d'initiatives et, par voie de conséquence, d'engagements. Une telle finalité stimule la fonction du crédit, encourage le profit et favorise par conséquent la réalisation des investissements. Il est donc hors de doute que le profit est le pivot de toute économie progressive: il comporte l'accumulation du capital et détermine également la réalisation des investissements dans le cycle suivant.

Mais le profit n'est pas un « élément » distinct du cours global de l'économie. Il est en effet étroitement lié à d'autres facteurs qui peuvent en substance être ramenés aux déterminants de stabilité de l'économie dans son ensemble. Il n'est pas facile de parvenir à cette situation ni de s'y maintenir, étant donné qu'à l'origine de l'instabilité se situent toutes sortes de causes: le gaspillage de ressources humaines et matérielles, le déséquilibre des Finances, l'absence de parité dans les rapports internationaux, le cours sinueux du taux des changes et du taux d'intérêt. Si ces phénomènes, individuellement ou conjointement, deviennent pathologiques, ils déclenchent des forces centrifuges qui peuvent occasionner des dérèglements d'importance, difficilement compressibles.

Dans ce décor à multiples facettes, le rôle de l'autorité centrale se trouve rehaussé, qui doit être à la fois en mesure de supprimer les obstacles qui pèsent sur la demande, et capable de résoudre les problematiques structurales relatives au marché des biens et à celui des services. Dans un contexte de ce genre, et nous nous référons tout particulièrement à l'exemple italien, toute politique économique doit également veiller à éliminer les faiblesses du crédit et du système monétaire. Il est par ailleurs indispensable de résoudre la très grave situation du Budget. Ces objectifs devraient susciter des réflexions non seulement sur les actions visant à des fins nationales, mais sur les projections réalisables, au même moment, dans le cadre du mouvement global du système international. À partir du rétablissement et de l'affermissement de conditions plausibles, l'on peut raisonnablement prévoir des profits engageants et concrétiser, ainsi, la faisabilité, d'une possible expansion.

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FANNO'S MODEL OF ECONOMIC FLUCTUATIONS: AN INTERPRETATIVE ANALYSIS

The paper analyses Marco Fanno's theory of economic fluctuations as was developed in his *La teoria delle fluttuazioni economiche*. Owing, may be, to the scarce mathematical support, both the first edition (1947) of this work and the second one (1956) contain few passages which present some interpretative difficulties.

In Fanno, progressive economies are subject to economic fluctuations which put in evidence the long-period expansion progress. In stationary economies, there are no cyclic movements. Given the hypothetical link between long-term expansion (*espansione secolare*) and potential expansion (*espansione potenziale*), Fanno overcomes the difficulties concerning the accelerator-multiplier models.

In Fanno's analysis, we find some points of contact with many other authors, e.g. Keynes, Schumpeter, Pigou, Mitchell, Fisher, Robertson and Aftalion. But Fanno's approach has a specific importance because he stresses the role of profit and the problem of time errors (*errori di tempo*).

Fanno (1947), like Hicks (1952), presents a cycle-trend model; but while Hicks emphazises the role of autonomous investments, Fanno discusses all types of investments which can yield profits. His reference to the marginal efficiency of capital offers a long period dynamic interpretation of Keynesian analysis.

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RECENT GROWTH THEORIES: AN ASSESSMENT

by
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1. *Introduction*

Growth theory has recently entered a period of ferment, following a quiescence of almost two decades.

By the early 1970's the fundamental elements of growth theory were an object of general consensus, at least on the western side of the Atlantic. On the other side, economists in the post-keynesian tradition were challenging the mainstream views, but their approach was followed by few, and was not so pervasive. Neoclassical theory, by contrast, formed the basis for a huge amount of theoretical work, and for empirical applications in growth accounting.

The range of issues that growth theory was expected to cope with was, however, quite narrow. Questions such as the explanation of persisting cross-country differences in per capita income levels and rates of growth, of continuing pressure for migration from low to high-income countries, and of the connections between population growth and income growth, were not addressed at all.

From a practical point of view, and from the point of view of policy advice, growth theory had very little to offer. Its concentration on abstract formalism, starting with the literature on optimal growth, initially re-explored by Cass (1965), was producing "Ramseyfications" of the original Solow model which were certainly useful for understanding the logic of dynamic optimization, but which did not offer interesting new insights. Not surprisingly, growth theory was discarded as esoteric by development economists, involved in a completely separate endeavor aimed at offering concrete

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policy advice that growth theory could not support. Recent contributions to growth theory, beginning with the work of Romer (1986) and Lucas (1988), are starting to change this state of affairs. The new models, beyond their rigorous formalism and impeccable microeconomic foundations, have something interesting to say about growth, even if the substantive contributions have so far been small.

In what follows I will try to summarize some of these recent developments. The review is not meant to be exhaustive; on the contrary it is fairly limited compared to the proliferation of theoretical and empirical articles on growth that has been taking place in the past five years. My aim is just to single out some representative models and to assess what new insights they provide for our understanding of the process of growth.

2. *General Methodology*

Virtually all recent growth models are different variants of equilibrium growth models. They focus on describing the dynamics of equilibrium paths, and work out the dynamics of wages and interest rates which would support equilibrium paths. The equilibrium concept is in general a complete markets competitive equilibrium with or without externalities. In some models (Romer, 1990a) imperfect competition, and in particular monopolistic price setting is modelled, but their dynamic behavior is identical to the case of competitive equilibrium with externalities.

The economy is imagined to be populated by a number of identical immortal consumers, who are more realistically replaced by a dynasty in models of the overlapping generation variety (Becker et al., 1990; Ehrlich and Lui, 1991). This consumer, or his dynasty, is supposed to be solving an infinite time utility maximization problem. For this consumer, firms are transparent instrumentalities for carrying out intertemporal optimization subject to initial endowments and technological constraints.

In terms of the technology, most models assume the existence of an aggregate production function, which can depend on a subset of the following inputs: services from physical capital, services from labor with a minimal level of schooling and training, services from additional human capital, and some measure of technology. This production function can exhibit constant or increasing returns, and in most models can be thought of as the technology available to the representative firm. In models of imperfect competition, by contrast, this function embodies elements of the technology and market structure relating producers of intermediate and final goods. An implicit assumption of all models is that at all dates markets clear at correctly anticipated prices.

Of course many of these assumptions are questionable, but this is not an issue for this review. The point is rather that of assessing whether these models, despite unrealistic assumptions, can depict growth in a useful way.

3. *Decificiences of the Standard Neoclassical Model*

Having set out the broad working framework of the new growth models, I will underline their essential features and conclusions while neglecting mathematical details and technicalities.

A good starting point is to analyze some practical deficiencies associated with the standard neoclassical model, on which recent theories try to improve.

The general properties of the model are very well known, and require no detailed recapitulation. Three of its major empirical flaws are the following.

The model predicts that growth of per capita output converges to zero in the steady state, unless exogenous technological change is introduced. As it is well known (Lucas, 1988), when including in the original model a production function of the type $Y_t = A_t F\ (K_t, L_t)$, with the level of technology (A_t) expanding at a fixed exogenous rate, the rates of growth of per capita capital, output, and consumption in the steady state become proportional to the given rate of technical change. In this framework, technological progress becomes the driving force behind sustained growth, but the fact that such an important determinant is taken to be exogenous is quite unsatisfactory from a theoretical point of view, besides being not useful at all in indicating possible policy actions aimed at increasing the long-run growth rate of per capita income.

Even setting aside the above observation, another major problem with the neoclassical model is its inability to explain the persisting differences in per capita income levels and growth rates across countries. Attributing these differences to exogenous differences in technology levels or to differences in preference parameters implies recognising the inability of economic theory to explain them.

Finally, the model predicts resources flows which are not observed. As Lucas (1990) points out, it is an implication of the neoclassical model that the returns to capital must be many times higher in the developing countries, where capital is relatively scarce, than in the developed ones. As a consequence most investment should take place in the LDCs, with capital flows continuing until the returns to capital are equalized. Differential policies and political risk may dampen this effect, yet the implied return differentials are too great to be explained by these factors alone.

Even when returns to capital become roughly equal, the model suggests that equalization of wages should also result. This contradicts the wage differentials that persist despite the huge migration of skilled and unskilled workers from less-developed countries.

Obviously, the assumptions about technology that give rise to these predictions must be inappropriate.

Given the empirical difficulties associated with the neoclassical model, and its irrelevance for policy prescriptions, a number of new models have recently been proposed to endogenize the growth process.

The two basic approaches underlying the new models of endogenous growth have been that of removing the fixed factor constraint of the neoclassical model by allowing constant or increasing returns to reproducible factors, or that of endogenizing technological change by explicitly modelling the introduction of new technologies.

4. *Increasing Returns Due to Externalities*

In standard neoclassical growth models there are constant returns to scale, perfect competition, perfect forsight (or rational expectations in non deterministic settings) and no externalities. The resulting competitive equilibrium paths are Pareto optimal. The first prototype of growth model hinging on a market failure was the learning by doing model by Arrow (1962). His comparison between market equilibria and social optima was confined to steady states. Later, Sheshinsky (1967) examined optimal growth with learning-by-doing, but he was rather elusive in characterizing non-steady state equilibrium paths and their comparisons with optimal paths.

Recent developments are improving this state of affairs, starting with the contributions by Romer (1986) and Lucas (1988), which are the first attempts to attain a better explanation of the process of economic growth and of intercountry differences in growth rates. As a by-product these two models have developed techniques for the analysis of non steady-state equilibrium growth paths that are not Pareto optimal.

Romer's (1986) model, which builds on the earlier model by Arrow (1962), is an equilibrium model of endogenous technological change in which long-run growth is driven by the accumulation of knowledge by forward-looking profit-maximizing agents.

At each point in time, knowledge is completely embodied in capital goods. New knowledge is assumed to be the product of a research technology that exhibits decreasing returns. In addition, investment in knowledge gives rise to a natural externality: as knowledge cannot be perfectly patented or kept secret, its creation by one firm is assumed to have a positive external effect on the production possibilities of other firms. As a consequence, production of goods as a function of knowledge and other inputs exhibits increasing returns in the aggregate: knowledge has an increasing marginal product for the whole economy.

Formally, the production function for an individual firm can be seen as

$$Y_{it} = F(k_{it}, K_t, x_{it}),$$

where k_{it} and x_{it} are firm-specific inputs and $K_t \, (= \sum_i k_{it})$ is the aggregate level of knowledge, which the individual firm takes as given.

The function is assumed to exhibit constant returns on k_i and x_i for a given K, so that the individual firms can behave competitively; but, in the aggregate, when K can vary, the production function exhibits increasing returns to scale. In other words, there is increasing rather than decreasing marginal productivity of knowledge from an aggregate point of view.

Under the assumption of zero growth in the labor force, Romer characterizes the equilibrium paths and the steady state solutions for the competitive case, in which intertemporal optimization occurs through private decisions by owner-consumers, and for the social optimum case, in which a fully informed, benevolent central planner maximizes through consumption choices the individuals' utility over time. In both cases per capita output shows constant, or even increasing, growth in the steady state. Along the equilibrium path both the level and the growth rate of per capita income will be lower in the competitive case than in the centrally planned optimum. Because the private marginal productivity of knowledge falls short of its social marginal productivity, the amount of consumption at each point in time is too high, and the amount of research is too low in the competitive case.

Government intervention in Romer's model can achieve a higher growth rate. The suggested line of intervention would be to choose taxes or subsidies so as to equalize the after-subsidy private and social returns to knowledge.

In Romer's model, increasing returns to knowledge could also overturn standard results about convergence: capital might flow from countries with low per capita incomes and per capita capital stocks to more developed countries.

Although these results might be interesting, and even if the model is consistent with the possibility of sustained growth, it still does not provide a satisfactory explanation for the wide differences in growth rates across countries.

A qualitatively different model with increasing returns is that of Lucas (1988). Lucas' model builds on an early model by Uzawa (1965) and allows for human capital, as well as physical labor. More precisely, the model assumes a unique labor input, H, taken to be the sum of tangible and intangible human capital.

This input resembles quite closely physical capital: it is possible to increase H by investment, and this implies incurring a cost through devoting resources to the training of additional workers.

The model therefore is one with two capital goods, and with two sectors where investment can take place. The key sector determining the rate of growth is the one which produces new human capital. Crucial is the amount of resources devoted to this sector. The other sector produces consumption and capital goods, according to a production function which exhibits increasing returns in the aggregate. The external effect in this model is associated with human capital spillovers, of the type that would arise, say, from indirect training stemming from conversations between colleagues and coworkers.

Similarly to the previous model Lucas characterizes equilibrium growth paths and steady states for the competitive case and for the socially optimal case. In both cases unbounded growth is generated because of the accumulation of human capital. Owing to the presence of the external effect of human capital, the competitive equilibrium growth rates are lower than they would be in the centrally planned economy, with the inefficiency being larger the larger the external effect.

As far as the levels of human capital and per capita income are concerned, the model predicts that an economy which starts from low levels of physical and human capital will permanently remain below an initially better endowed economy; however, the model is still not consistent with large cross country differences in growth rates.

5. *Learning by Doing*

In the same 1988 article, Lucas develops a two-good elaboration of the model which allows more possibilities. Human capital is assumed to be specific to the production of a particular good, and is acquired through a process of learning by doing. In this set-up, when different goods have different potentials for human capital accumulation through learning by doing, then a country which, owing to its static comparative advantage, specializes in the production of the low human capital potential good will experience a lower growth rate of knowledge and per capita income compared to a country specialized in producing goods with high human capital potential.

This version of the model is consistent with permanent differences in growth rates across countries, but given the fixed set of goods it does not allow for within-country changes in growth rates. Obviously this requires continuous introduction of new goods, with learning-by-doing potentials decreasing as the production of a given good increases.

This idea is extended and formally modelled in the sophisticated model of learning by doing by Stockey (1988).

Dynamic effects of international trade in a learning-by-doing model are examined by Young (1991). He develops a model of endogenous growth generated by learning by doing which, although bounded in each good, exhibits spillovers across goods. The model is then used to analyze the impact on growth rates, rates of technical progress, and intertemporal consumer welfare of a movement from autarky to free trade of two economies, one of which is initially less technically advanced than the other.

With respect to growth rates, the model suggests that free trade will raise the rate of income growth of the more developed country and lower that of the less developed one. Intertemporal consumer welfare in the LDC is not necessarily reduced, but the final effect is ambiguous.

The results of the model are, indeed, rather weak. In particular, the effects of international trade on research and development, on the acquisition of human capital, and international spillovers of knowledge are not considered, although these effects could create quite different results.

6. *Research and Development*

A different class of models concentrates on the effects of research and development on the rate of technological progress and growth. Two examples are the contributions by Romer (1990a) and by Grossman and Helpman (1991).

In Research-and-Development (R&D) models, endogenous growth is generated by the development of new varieties of intermediate or final goods (or of old goods with new processes), which is in turn made possible by the output of a research and development sector.

In particular R&D generates two kinds of output: the first type is product-specific information which enables a firm, which possibly acquires a patent for the new design, to produce a new capital or consumption good. The second type of output is intangible in nature and comprises more general technical information and knowledge which, by its very nature, becomes publicly available. This intangible knowledge is intrinsically non rival, consisting of ideas which, once produced, can be used at no cost by any agent.

Spillovers of knowledge introduce non convexities, and price-taking competition cannot be supported. The crucial endogenous variable for growth is the amount of resources (human capital) devoted to the R&D sector, but in general the market will not provide a socially optimal allocation.

In the absence of interventions, the resources allocated to the sector of ideas may be too low and innovation, and therefore the growth rate, may be suboptimally slow in the market equilibrium.

Grossman and Helpman's model of R&D also examines a number of channels through which international trade might affect the long run rate of innovation and growth. Their first observation is that the growth rate will in general be faster when technical knowledge flows readily across countries compared to a situation where all such knowledge has to be produced locally. Trade therefore may positively affect growth by facilitating the exchange of information and knowledge diffusion during the arrangement of commercial transactions. Trade will also induce competition in the innovation process, and reduce duplication of research effort, thereby increasing the aggregate productivity in the sector of ideas.

There are cases in which trade will lower the incentives for research, so that a country's rate of growth may be lower in the trade equilibrium than in autarky.

International competition with a technologically advanced country may lead to a slowing of innovation and growth in a country which starts with a disadvantage in research productivity; a country which is well endowed with unskilled labor may be led by its comparative advantages to specialize in traditional manufacturing, devoting fewer and fewer resources to advances in knowledge, with a resulting drop in the overall growth rate.

Even if free trade could slow down a country's growth rate, however, the intertemporal utility of consumers will not necessarily worsen. The results are quite similar to those of Young (1991).

7. *Human Capital, Fertility Choices and Economic Growth*

All the models summarized up to this point concentrate on identifying potential engines of growth and on specifying their mechanics in a simplified framework in which the representative decision-makers are assumed to be infinitely lived. Another group of recent models has abandoned this simplifying assumption, and has focused on the specific motivating factors which link successive generations and may play a critical role in determining the pace of growth as well as its dynamics. These models concentrate on endogenous links between human capital, fertility, and economic growth.

An example is the model by Becker, Murphy and Tamura (1990). Human capital, or knowledge embodied in people, is the underlying engine of growth in this model, and parental altruism is identified as the factor that motivates agents to allocate sufficient resources to promote in their successors a stock of human capital which is higher than their own. The model adopts a dynastic utility maximization rule in which altruistic parents maximize the aggregate utility of their dynasty, but not necessarily the individual utility of each of their descendants. A further assumption is that the rates of return on human capital are increasing in the stock of human capital, at least up to a certain point. The justification provided for this assumption is that the educational sector, as well as other sectors which produce human capital use educated and skilled inputs more intensively than sectors which produce consumption or capital goods.

When human capital is scarce, rates of return on human capital are low relative to rates of return on children, and the opposite holds when human capital is abundant. As a result societies with little human capital will choose large families and invest little in each child, while societies with abundant human capital will do the opposite.

This leads to the existence of two possible stable steady states: one characterized by large families, little human capital, and slow growth, where the economy is stuck in a poverty trap, and one with small families, high human capital, and growing per capita output.

A more elaborate model of human capital fertility and growth is provided by Ehrlich and Lui (1991), who identify the motivating forces behind parents' investment in their children in mutual emotional and material dependence.

Parents enjoy direct utility from the children's behavior through mutual love and respect, and when they reach old age they become dependent on their children for material support. Children depend on their parents for their material needs and for the acquisition of productive knowledge. In this model implicit self-reinforcing contracts involving intergenerational trade determine the process of accumulation of human capital which in turn induces growth.

Ehrlich and Lui's model, similarly to the previous model, generates two possible steady states: one stagnant equilibrium of zero (or low) growth and a self-generating growth equilibrium. Exogenous increases in young-age longevity in this model can unambiguously raise the economy's long-run rate of growth. In fact a large increase in longevity would destabilize the stagnant equilibrium and drive the economy into a growth equilibrium during which fertility declines continuously.

8. *Conclusions*

Have these new theories brought significant advances in our understanding of the growth process? From a theoretical and methodological point of view they certainly have. They have underlined as the main determinants of growth capital accumulation, human capital, learning-by-doing, research and development, and innovation. They suggest that markets will not always provide an optimal amount of knowledge, and provide scope for policy interventions. Most importantly they provide a comprehensive methodological framework for the analysis of the growth process.

From a practical point of view, however, the substantive contributions have been quite small indeed. Each model emphasizes a different issue, and none of them has been properly empirically tested to quantify the importance of each issue. Theoretical and empirical evidence is still too weak to rely on these models for any policy advice.

There is a further aspect of this kind of models which strikes one as ultimately implausible: the automatic presumption that observed paths are full equilibrium paths, and that the equilibrium paths themselves are unaffected by the short-to-medium-run experience.

Basic medium-run questions such as possible price rigidities, financial constraints, labor market segmentation, infrastructure, imperfect information, income distribution, and economic and institutional organizations have been ignored by growth models so far. Yet they are undeniably determinant factors influencing each country's actual growth path.

Attention, in my opinion, should now turn to these issues. Analytical tools have evolved to the point where formal quantitative analysis of these aspects will be possible.

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NOTA SULLE RECENTI TEORIE DELLA CRESCITA

Questo articolo esamina alcuni recenti contributi alla teoria della crescita. La rassegna non intende essere esaustiva; il suo scopo è piuttosto quello di individuare alcuni modelli rappresentativi e valutare il loro contributo alla comprensione del processo di crescita economica. Dopo una breve introduzione ed una descrizione della metodologia generale vengono presi in esame modelli di crescita endogena basati rispettivamente su rendimenti crescenti, learning by doing, ricerca e sviluppo, capitale umano e scelte di fertilità. Per ciascun modello sono evidenziate le caratteristiche essenziali e le conclusioni, trascurando i dettagli matematici e i tecnicismi.

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SPECULATION AND EXCHANGE RATE VOLATILITY: DOES THE DEGREE OF PRICE FLEXIBILITY MATTER?

by
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1. *Introduction*

Whether private speculation in forward exchange stabilize or destabilize exchange-rate movements has become the focus of recent work, such as Driskill and McCafferty (1982), Kawai (1984), Eaton and Turnovsky (1984), among others. The recent focus was seemingly motivated by two events. One is the large fluctuation of exchange rates that have been featuring the floating-rate system since 1973. This disappointing development calls into question the role of rational profit-taking speculation in foreign exchange markets.

Another refers to the empirical failure of the forward exchange rate to be an unbiased estimator of the future spot rate (e.g. Geweke and Feige, 1979; Frankel, 1980; Hansen and Hodrick, 1980 and others). Such empirical evidence implies that, even in the long run, speculators may profit by taking an open position in the forward exchange market [1]. A risk premium – the discrepancy between the forward rate and the future spot rate – then serves as a reward to speculators that are willing to assume exchange risk. International commodity traders and interest arbitragers can therefore be insured from exchange risk by "paying" a market-determined risk premium to speculators [2].

Has the response of private speculators to the market-determined risk premium deteriorated exchange rate variability? The answer was mixed in

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[1] An open position refers to the situation in which the value of speculators' assets are subject to exchange rate movements.

[2] In fact, commodity traders and interest arbitragers do not directly pay a risk premium to speculators. The interaction among the three agents will be spelled out later in Section 2.

the literature, depending on the origin of shocks that perturbed the economy concerned (e.g. Eaton and Turnovsky, 1984).

Recent analysis of forward market speculation, however, all built on the two critical assumptions that both purchasing power parity (PPP) and covered interest parity (CIP) held continuously over time [3]. Namely, in recent works, domestic and foreign goods are homogeneous and their prices are perfectly flexible, on the one hand, and domestic and foreign bonds are perfect substitutes on a covered basis, on the other hand.

True, the two assumptions much simplify theoretical analysis. But, they rule out the likelihood that private speculation may have opposite effects on exchange-rate variability corresponding to various degrees of price flexibility and/or mobility (i.e. asset substitutability). Such concern is of importance, not only in its own right, but to the failure of PPP and CIP to gain empirical support (e.g. Cumby and Obstfeld, 1981; and Dornbusch, 1985).

The aim of this paper is to address the aforementioned issue for a small, open economy. Specifically, this paper studies whether or not increased speculation in forward exchange may reduce exchange-rate volatility (as measured by the one-period variance of the spot exchange rate), taking into account various degrees of price flexibility and capital mobility. Two random shocks are assumed to impinge on the economy in a stochastic macroeconomic model. One is a real shock originating in the domestic goods market, and the other is a nominal shock originating in the domestic money market. To bring this study into the focus, all foreign shocks are ignored in this paper.

Extension often brings about structural complexities, however. Analytical treatment becomes intractable because the PPP and CIP hypotheses are relaxed. This study, therefore, resorts to numerical simulation.

The major findings of this study are summarized as follows. First, insofar as exchange-rate volatility is concerned, the role of forward market speculation appears insensitive to the degree of capital mobility, whether the shock is real or monetary. But, this is not the case when the domestic monetary shock perturbs the economy. For example, as indicated by simulation, increased speculation tends to be stabilizing the spot exchange rate against the monetary shock when the price of goods is sufficiently flexible, while causing greater fluctuations of it when the price is rather sticky. The

[3] Earlier models of foreign exchange markets, such as TSIANG (1959), SPRAOS (1959), GRUBEL (1966), SOHMEN (1969), and MCCORMICK (1977) among others, are all partial equilibrium models. In contrast to more recent models, these models did not treat agents' expectations rationally.

finding that links the role of forward market speculation to the degree of price flexibility has not yet been noted in the literature [4].

The above results convey a policy implication. Tobin (1978) suggested to "put some sand in the wheels of international finance". His proposed scheme was a moderate, world-wide transactions tax on foreign exchange, which might discourage both interest arbitrage and forward speculation. This study suggests that such tax deterrents to international hot money may, or may not, dampen the highly volatile exchange-rate movements under the current floating exchange-rate system. Other than the origin of shocks, as noted by the recent literature, the degree of price flexibility also plays a role in determining whether private speculation is a stabilizing or destabilizing element insofar as exchange rate variability is concerned.

Section 2 of this paper outlines the model. Section 3 solves the equilibrium spot rate under the rational expectations hypothesis, and computes its one-period variance to measure the magnitude of exchange-rate volatility. Section 4 conducts numerical simulation including sensitivity analysis, while concluding remarks are given in Section 5.

2. *The Model*

The model presented here is based on Tseng (1991) and summarized by the following equations [5].

Domestic goods market:

$$(1) \qquad d_t = b_1 a_t + b_2 T_t \qquad b_1 > 0, \qquad b_2 > 0$$

$$(2) \qquad a_t = \alpha_1 y - \alpha_2 r_t + u_{1t} \qquad 1 > \alpha_1 > 0, \qquad \alpha_2 > 0$$

$$(3) \qquad T_t = T_t^s + T_t^f$$

$$(4) \qquad T_t^s = \beta\,(e_t^s + p_t^* - p_t) \qquad \beta > 0$$

$$(5) \qquad T_t^f = \delta\,(e_{t-1}^f + E_{t-1}\,[p_t^*] - E_{t-1}\,[p_t]) \qquad \delta > 0$$

[4] In DORNBUSCH's (1976) celebrated work, price stickiness was firstly shown to make exchange rates more volatile when an unanticipated monetary shock occurred. This paper takes a further step by asking whether rational profit-taking speculation can reduce such volatility in different degrees of price stickiness.

[5] TSENG (1991) was concerned with the effects on exchange-rate variability of official intervention in the forward exchange market. In contrast, this study focuses on the effects of private speculation.

$$p_t = p_{t-1} + \Phi(d_t - y) \qquad \Phi > 0 \tag{6}$$

Domestic money market:

$$m - p_t = \Omega_1 y - (1/\Omega_2) r_t + u_{2t} \qquad \Omega_1 > 0,\ \Omega_2 > 0 \tag{7}$$

Foreign exchange markets:

$$K_t = \mu (e_t^f - e_t^s + r_t^* - r_t) \qquad \mu > 0 \tag{8}$$

$$Z_t = \tau (E_t[e_{t+1}^s] - e_t^f) \qquad \tau > 0 \tag{9}$$

$$T_{t+1}^f + K_t = Z_t \tag{10}$$

$$T_t^s + Z_{t-1} = K_t \tag{11}$$

Foreign variables:

$$p_t^* = \bar{p}^* \tag{12}$$

$$r_t^* = \bar{r}^* \tag{13}$$

where all variables except letters, r and r^* are measured in logarithms; the subscript t denotes period t and $E_t[\cdot]$ is an expectation operator based on all available information in period t. The definition of each variable is given below:

d = domestic real aggregate demand
a = domestic real absorption
T = real aggregate trade balance
T^s = real spot trade balance
T^f = real nonspot (hedged) trade balance
y = domestic output level (which is assumed to be fixed)
r = domestic nominal rate of interest
e^s = the spot exchange rate (measured in terms of units of domestic currency per unit of foreign currency)
$E_t[X_{t+1}]$ = expectations of X in period $t+1$ conditional on information available in period t, where $X = p$, e_s, p^*
e^f = the forward exchange rate (measured in terms of units of domestic currency per unit of foreign currency)
p = domestic goods price
m = domestic nominal money supply
K = the arbitragers' real stock demand for foreign exchange

Z = the quantity of forward contracts purchased by private speculators
p^* = foreign price level; $\bar{p}^*$ = long-run stationary level of p^*
r^* = foreign nominal rate of interest; $\bar{r}^*$ = long-run stationary level of r^*
u_1 = random disturbance in domestic absorption
u_2 = random disturbance in excess supply of domestic nominal money

The domestic goods market is characterized by equations (1)-(6). Equation (1) is a log-linearized aggregate demand function. Domestic aggregate demand (d_t) is composed of the real domestic absorption (a_t) and the real trade balance (T_t) in period t [6].

Equation (2) states that the current real domestic absorption, a_t, depends positively on the (fixed) real domestic output, y, and negatively on the current domestic nominal rate of interest, r_t, rather than the real rate of interest, for simplicity [7]. The current domestic absorption is also subject to the stochastic disturbance, u_{1t}, which contains random changes in domestic fiscal policy or private consumption and investment. Equation (3) is an identity with the real trade balance (T_t) equal to the spot trade balance (T_t^s) plus the nonspot trade balance (T_t^f).

The spot trade balance, as indicated by equation (4), depends on the current terms of trade, $(e_t^s + p_t^* - p_t)$. The sign of β is positive, indicating that the Marshall-Lerner condition holds. The nonspot trade balance is determined by the expected terms of trade, $(e_{t-1}^f + E_{t-1}[p_t^*] - E_{t-1}[p_t])$, according to equation (5). Notice that since export and import decisions are made by spot traders at the time when they face the current spot rate, they are not subject to exchange risk. Nonspot traders, however, face a technological lag between the time of making trade commitments and the time of receiving (or paying) foreign currency. Since the spot rate at the time of actual delivery is uncertain, nonspot traders do confront exchange risk. The existence of the forward exchange market provides a tool for nonspot traders to hedge against exchange risk. They enter into forward contracts in period $t-1$, the time of making commitments, to deliver (or receive delivery of) specified units of foreign currency in period t, the time of actual delivery, in exchange for domestic currency at a stipulated forward exchange rate [8].

[6] This specification of domestic aggregate demand is based on BHANDARI (1983).

[7] In fact, this simplicity specification is based on DORNBUSCH (1976).

[8] Hence, for nonspot traders, their expected terms of trade [in eq. (5)] is based on the currently known forward rate e_{t-1}^f rather than the currently future spot rate $E_{t-1}[e_t^s]$.

Equation (6) stipulates the price adjustment rule, where the positive parameter, Φ, represents the speed of price adjustment in response to excess demand for domestic goods, $(d_t - y)$ [9]. The greater the parameter Φ, the more flexible will be the price adjustment. As Φ goes to infinity, the goods market is continuously cleared along the time horizon. Equilibrium in the domestic money market is characterized by equation (7), in which the stock level of domestic nominal money supply is assumed to be fixed, and the domestic real money demand, subject to the random disturbance u_{2t}, is associated positively with the (fixed) domestic real income, y, and negatively with the domestic nominal rate of interest, r. This disturbance u_{2t} can be taken as random changes in monetary policy or private money demand.

Equations (8)-(12) specify the operation of the spot and forward exchange markets. Equation (8) shows that the desired stock holding of spot foreign exchange, K_t, is determined by the covered interest-rate differential $(e^f_t - e^s_t + r^*_t - r_t)$ and the degree of capital mobility μ (or called the degree of asset substitutability). Here it is assumed that all spot foreign-exchange transactions due to interest arbitrage, K_t, are perfectly hedged in the forward market. Hence, K_t represents both a current-period excess demand for spot exchange and a current-period excess stock supply of forward foreign exchange.

Equation (9) states the excess stock demand for forward speculation, Z_t, as being positively associated with private speculators' anticipated risk premium $(E_t[e^s_{t+1}] - e^f_t)$ and the degree of speculative elasticity (τ).

Equation (10) is a market-clearing condition for forward exchange. The excess hedging supply $(T^f_{t+1} + K_t)$ matches the excess speculation demand (Z_t). Here, one can clearly see how nonspot traders and interest arbitragers shift away exchange risk by selling forward exchange to speculators, who assume the risk by purchasing forward exchange. The forward exchange market therefore becomes a place where agents can shift or assume exchange risk.

Equation (11) is a market-clearing condition for spot exchange. The spot traders generate an excess supply of spot exchange due to the current-period spot trade surplus (T^s_t), and the speculators receive delivery of spot exchange as a result of the last period's forward speculation (Z_{t-1}). In equilibrium, the amount of excess supply of spot exchange $(T^s_t + Z_{t-1})$ equals the covered interest arbitragers' excess demand for spot exchange (K_t). Equations (12) and (13) state that both foreign nominal foreign

[9] This price adjustment rule is a modified version of DORNBUSCH's (1976). In contrast to his version, the goods price is not predetermined in this model.

price, p_t^*, and foreign nominal rate of interest, r_t^*, are exogenous and exhibit random movements around their long-run stationary equilibrium $\bar{p}^*$ and $\bar{r}^*$ respectively.

There are two random disturbances in this model. One is a real shock (u_1), and the other is a monetary shock (u_2). They perturb the system through different channels: u_1 through the domestic goods market and u_2 through the domestic money market. For simplicity, they are assumed to be independent of each other with mean $E_t[u_{jt+1}] = 0$ and a bounded variance, $V_t[u_{jt+i}] < \infty$ for $j = 1, 2$ and $i \geq 1$.

3. *Derivation of Rational Expectations Equilibria*

In this model, there are three endogenous variables – e_t^s, e_t^f, p_t – to be determined. The first step is to obtain a set of reduced form equations [10]. Using (1), (2), (3), (4), (5), (7) and (12), the domestic-price adjustment equation (6) becomes,

$$(14a) \quad p_t = \theta_1 e_t^s + \theta_2 e_{t-1}^f + \theta_3 p_{t-1} - \theta_2 E_{t-1}[p_t] + \theta_4 u_{1t} - \theta_5 u_{2t}$$

where

$$\theta_1 = \frac{\Phi b_2 \beta}{\Delta} > 0 \qquad \theta_2 = \frac{\Phi b_2 \delta}{\Delta} > 0$$

$$\theta_3 = \frac{1}{\Delta} > 0 \qquad \theta_4 = \frac{\Phi b_1}{\Delta} > 0$$

$$\theta_5 = \frac{\Phi b_1 \alpha_2 \Omega_2}{\Delta} > 0$$

with

$$\Delta = 1 + \Phi b_2 \beta + \Phi b_1 \alpha_2 \Omega_2 > 0$$

Using (5), (7), (8), (9), (12) and (13), the forward-market clearing condition (10) can be written as,

$$(14b) \quad E_t[e_{t+1}^s] = -\Gamma_1 e_t^s + \Gamma_2 e_t^f - \Gamma_3 p_t - \Gamma_3' E_t[p_{t+1}] - \Gamma_3 u_{2t}$$

where

[10] For simplicity, m, y, $\bar{p}^*$, and $\bar{r}^*$, are set equal to zero.

$$\Gamma_1 = \frac{\mu}{\tau} > 0 \qquad \Gamma_2 = \frac{\delta + \mu + \tau}{\tau} > 0$$

$$\Gamma_3 = \frac{\mu \Omega_2}{\tau} > 0 \qquad \Gamma_3' = \frac{\delta}{\tau} > 0$$

Using (4), (7), (8), (9), (12) and (13), the spot-market clearing condition (11) becomes,

$$(14c) \qquad e_t^f = \Psi_1 e_t^s + \Psi_2 E_{t-1}[e_t^s] - \Psi_2 e_{t-1}^f - \Psi_3 p_t + \Psi_4 u_{2t}$$

where

$$\Psi_1 = \frac{\beta + \mu}{\mu} > 0 \qquad \Psi_2 = \frac{\tau}{\mu} > 0$$

$$\Psi_3 = \frac{\beta - \mu \Omega_2}{\mu} >< 0 \qquad \Psi_4 = \Omega_2 > 0$$

To solve the economic system represented by the reduced-form equations (14a)-(14c), one may use a two-step procedure, given the assumed Muthian rational expectations (Muth, 1961) [11]. First, find the solution for the expectations variables, $E_{t-1}[p_t]$, $E_t[p_{t+1}]$, $E_{t-1}[e_t^s]$ and $E_t[e_{t+1}^s]$ by taking expectations of (14a)-(14c) conditional on period $n < (t-1)$, which washes out the disturbance variables u_{it} $(i = 1, 2)$, and then solving the resultant equations simultaneously. Second, substituting the solution for those expectations variables back into (14a)-(14c) yields a system of second-order equations, which can be solved to obtain [12]:

$$e_t^s = \sum_{j=1}^{2} \left[M_{j1} \sum_{k=0}^{\infty} \lambda_1^k (u_{j,t-k}) + M_{j2} \sum_{k=0}^{\infty} \lambda_2^k (u_{j,t-k}) \right]$$

$$(15) \qquad + \left[N_1 \sum_{k=0}^{\infty} \lambda_1^k (u_{2,t-k-1}) + N_2 \sum_{k=0}^{\infty} \lambda_2^k (u_{2,t-k-1}) \right]$$

$$+ \left(\frac{\omega_t(\cdot)}{P(L)} + B_1 \lambda_1^t + B_2 \lambda_2^t \right)$$

where M's, N's and B's are the coefficients subject to the structural equations (1)-(14), $\omega(\cdot)$ is a linear combination of $E_t[p_{t+1}]$ and $E_t[e_{t+1}^s]$, λ's are the characteristic roots, and $P(L)$ is a second-order function of the lag operator. Note that λ_1 and λ_2 can be solved by setting $P(1/\lambda) = 0$. Since

[11] The detailed procedure with the stability analysis is available from the author upon request, or see EATON and TURNOVSKY (1984) for a similar solution technique.

[12] Since the distribution of p_t and e_t^f are irrelevant to subsequent analysis on spot-rate variability, they are omitted.

both λ_1 and λ_2 are shown to be less than unity, the economic system is stable, given bubble-free expectations [13].

4. *Numerical Simulation*

For the purpose of exposition, this paper assumes that variance of each random disturbance u_{jt+i} conditional on all currently available information is equal to unity, i.e., $V_t[u_{1t+i}] = V_t[u_{2t+i}] = 1$, and that the two random disturbances do not jointly impinge on the economy. Using equation (15), the degree of exchange-rate volatility due to disturbance j is measured by the one-period conditional variance of e^s_{t+1} [14]:

$$V^j_t[e^s_{t+1}] = M^2_{j1} + M^2_{j2} + 2M_{j1}M_{j2} \tag{16}$$

Because of structural complexities implied in equation (16), it is impossible to analytically treat the effects of forward speculation on the degree of spot-rate volatility. Hence, this study adopts numerical simulation.

4.1. *Choice of Parameter Values.* – A set of parameter values is given in Table 1. The choice of each parameter value is discussed below.

First, the share of domestic absorption in aggregate demand, b_1, is arbitrarily set equal to 0.90 [15]. This implies that the linearization constant b_2 is determined to be 0.10 [16].

Second, the parameter, α_2, measures the interest-rate semi-elasticity of domestic absorption. Given an assumed elasticity of 0.01 and a quarterly interest yield of 3.33% (Note that the horizon of the models is assumed to extend over one quarter), the semi-elasticity, α_2, is around 0.30 [17].

Third, most empirical estimates indicate that the interest-rate elasticity of real money demand is around 0.02. It thus turns out that the interest-rate semi-elasticity, $1/\Omega_2$, is .6667 or $\Omega_2 = 1.5$ approximately [18].

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[13] By bubble-free expectations, we mean that the expectations variables, such as $\omega_t(\cdot)$ of equation (15), will not be explosive over time.

[14] Hence, equation (16) is a better measure of short-run, rather than long-run, variability of the spot rate.

[15] This assumed value is more or less consistent with empirical evidence of U.S. and Japan, though.

[16] Note that equation (1) is a log-linearized aggregate demand function.

[17] $\alpha 2 = \dfrac{\partial \log a}{\partial r} = \dfrac{\partial \log a}{\partial \log r}\dfrac{\partial \log r}{\partial r} = \dfrac{\partial \log a}{\partial \log r}\dfrac{1}{r} = \dfrac{.01}{.033} \cong .30.$

[18] The derivation is similar to the above.

Table 1

PARAMETER VALUES

Base	Parameter Set	Variants					
b_1	.9						
b_2	.1						
α_2	.3						
β	.1						
δ	.5						
Ω_2	1.5						
τ	60	1	5	10	30	100	200
μ	60	1	5	10	30	100	200
Φ	.5	.001	.01	.05	1	5	10

Remark: the values of α_1 and Ω_1 are irrelevant because their associated variable y is set equal to zero; see equations (2) and (7).

Fourth, while there has not been sufficient empirical evidence, it is assumed that the semi-elasticity of spot trade balance with respect to the current terms of trade, β, is less than that of non-spot trade balance with respect to the expected terms of trade, δ, (i.e. $\delta > \beta$). This assumption seems plausible since it is technologically more difficult for an immediate response of the spot trade to a change in the terms of trade in the real world. Considering some empirical estimates (e.g. Goldstein, 1980), the parameter β is set equal to .10, and the parameter δ equal to 0.50.

Finally, without reliable empirical evidence, the speculation elasticity, τ, is allowed to range from 0 to 200. With the same consideration, the degree of price flexibility, Φ, is allowed to range from .001 to 10 and the degree of capital mobility, μ, from 1 to 200. Notice that the degree of price flexibility refers to the elasticity of the domestic price with respect to the current excess demand for domestic goods. So the chosen parameter values of Φ consist of those that are inelastic ($\Phi < 1$), unit elastic ($\Phi = 1$) or elastic ($\Phi > 1$).

Given the base parameter set, the first part of the numerical simulation is conducted by allowing the speculation elasticity τ to change from 0 to 200. Using the assumed parameter values, the author of this paper wrote a FORTRAN program (which is available upon request) to calculate the degree of spot-rate variability (eq. (17)) for each given value of the speculation elasticity (τ). The second part is sensitivity analysis, where given other parameters held constant, the degree of spot-rate variability is calculated for each possible combination of Φ and μ.

4.2. *Results under the Base Parameter Set.* – Table 2 reports the degree of spot-rate volatility corresponding to different degrees of the speculation elasticity (τ) under the base parameter set, when the domestic absorption or monetary disturbance perturbs the economy. One common feature stands out of the table. Increased speculation (i.e. the increase in τ) unambiguously augments the variance of the spot rate, whether u_1 or u_2 is present. It suggests that private speculation (in response to a risk premium) tends to destabilize the spot rate against each shock.

TABLE 2

VARIANCE OF SPOT RATES UNDER THE BASE PARAMETER SET

τ	u_1 absorption shock	u_2 monetary shock
1	.2466	1.3754
5	.2890	1.4895
10	.2974	1.5104
30	.3036	1.5265
60	.3052	1.5307
100	.3059	1.5324
200	.3064	1.5337

Another result from Table 2 also deserves attention. The speculation elasticity (τ) ranges from 1 to 200. Over such a wide range, each variance of the spot rate turns out to be far below unity in the presence of the domestic absorption disturbance (u_1), while exceeding unity in the presence of the domestic monetary disturbance (u_2). With Var (u_1) and Var (u_2) being fixed at unity, these results imply that, compared with the shock's own fluctuation, a monetary shock tends to cause a greater exchange-rate fluctuation and a real shock to bring a smaller one.

Of course, the findings above are merely tentative. As mentioned earlier, there remains lack of reliable empirical evidence on the degree of price flexibility (Φ) and the degree of capital mobility (μ). Hence, it is particularly important to see if the results from the base parameter set are sensitive to changes in the two parameters.

4.3. *Sensitivity Analysis.* – Table 3 reports the results of sensitivity analysis

TABLE 3

VARIANCE OF SPOT RATES UNDER SENSITIVITY ANALYSIS; DOMESTIC ABSORPTION SHOCK (u_1)

μ	$\mu = 10$			$\mu = 60$			$\mu = 200$		
τ/Φ	.001	.5	5	.001	.5	5	.001	.5	5
1	.1414	.2400	3.5868	.1453	.2466	3.6836	.1459	.2476	3.6974
5	.1658	.2812	4.1910	.1704	.2890	4.3054	.1711	.2901	4.3217
10	.1706	.2893	4.3099	.1754	.2974	4.4278	.1761	.2985	4.4446
30	.1742	.2953	4.3980	.1791	.3036	4.5185	.1798	.3048	4.5357
60	.1751	.2969	4.4212	.1801	.3052	4.5425	.1808	.3064	4.5597
100	.1755	.2976	4.4307	.1804	.3059	4.5522	.1811	.3071	4.5695
200	.1758	.2981	4.4378	.1807	.3064	4.5596	.1815	.3076	4.5769

Remark: each entry of variances under $\Phi = .001$ has been multiplied by a factor of 10^5.

when the domestic absorption disturbance is present. It is clear from the table that increased speculation is seen to increase the variance of the spot rate (in the presence of this real shock) in all cases. That is, the destabilizing role of private speculation turns out to be robust to the degree of both capital mobility and price flexibility.

In contrast, this may not be the case in the presence of the domestic monetary disturbance (u_2). As indicated by Table 4, regardless of the degree of capital mobility (μ), increased speculation is seen to increase the variance

TABLE 4

VARIANCE OF SPOT RATES UNDER SENSITIVITY ANALYSIS; DOMESTIC MONETARY SHOCK (u_2)

μ	$\mu = 10$			$\mu = 60$			$\mu = 200$		
τ/Φ	.001	.5	5	.001	.5	5	.001	.5	5
1	1.9394	1.3575	.2617	1.9698	1.3754	.2605	1.9741	1.3780	.2604
5	2.1266	1.4681	.2544	2.1615	1.4895	.2532	2.1664	1.4915	.2530
10	2.1629	1.4894	.2531	2.1986	1.5104	.2518	2.2037	1.5134	.2516
30	2.1896	1.5105	.2521	2.2260	1.5265	.2508	2.2312	1.5295	.2506
60	2.1966	1.5092	.2518	2.2333	1.5307	.2505	2.2385	1.5338	.2504
100	2.1995	1.5019	.2517	2.2362	1.5324	.2504	2.2414	1.5355	.2502
200	2.2017	1.5122	.2516	2.2384	1.5337	.2503	2.2436	1.5368	.2501

of the spot rate (due to the monetary shock) if the degree of price flexibility (Φ) equals .001 or .5, while decreasing the same variance if the degree of price flexibility equals 5. That is, whether or not speculation can stabilize spot-rate movements against the monetary shock is irrelevant to the degree of capital mobility, but dependent upon the degree of price flexibility. When price adjustments for disequilibrium in the goods market are sufficiently elastic ($\Phi = 5$), increased speculation helps reduce spot-rate volatility. Rather, when such price adjustments are sufficiently inelastic ($\Phi = 0.001$ or .5), increased speculation is destabilizing. Thus, price flexibility becomes a key factor in determining the role of private speculation.

Unlike the degree of capital mobility, the degree of price flexibility also determines whether the real or monetary shock can induce a degree of spot-rate volatility that exceeds the degree of the shock's own fluctuation. For example, as shown by Table 3, with the degree of price flexibility being as high as 5, the real shock results in an excessive fluctuation of the spot rate (i.e. Var (e^s) > 1). To the contrary, with the degree of price flexibility being as low as .001 or .5, the monetary shock provokes a similarly excessive fluctuation of the spot rate. This asymmetric result modifies the preceding finding of Section 4.2, where the domestic real shock (u_1) fails to induce a high degree of spot-rate volatility relative to the degree of the shock's own instability.

5. *Concluding Remarks*

This paper studies the effects of forward market speculation on spot-rate volatility in a stochastic macroeconomic model for a small economy. It abandons the hypotheses of PPP and CIP, which were often imposed in the literature. This extension generates structural complexities, and thus numerical simulation is employed. The paper obtains the two major results:

First, when the domestic real (absorption) shock perturbs the economy, increased speculation in forward exchange tends to deteriorate fluctuations of the spot rate. Further, this destabilizing effect is found to be robust to various degrees of price flexibility and capital mobility.

Second, when the domestic monetary shock brings perturbation into the economy, increased speculation in forward exchange may not necessarily augment the degree of spot-rate volatility, crucially depending on the degree of price flexibility. It is found that increased speculation may be stabilizing when the domestic price is sufficiently flexible. The degree of capital mobility appears irrelevant in this regard.

The paper suggests no room for private speculation to play a stabilizing role against unanticipated real shocks, insofar as exchange-rate variability is concerned. Of course, this point is merely suggestive, instead of conclusive, due to the limitation of any simulation approach.

This paper requires further extension in the future. First of all, the economy's output should be allowed to deviate from its full-employment level in the short run. In so doing, it would be important to distinguish between short-term and long-term fluctuations of exchange rates. This paper ignores the latter.

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SPECULAZIONE E VOLATILITÀ DEI CAMBI: È IMPORTANTE IL GRADO DI FLESSIBILITÀ DEI PREZZI?

Questo articolo esamina se la speculazione privata nei cambi a termine può destabilizzare i movimenti dei cambi in un modello macroeconomico stocastico. La simulazione numerica suggerisce che sotto questo aspetto il grado di flessibilità dei prezzi è un fattore importante. L'implicazione di politica economica è che non è affatto certo che una politica fiscale volta a scoraggiare i movimenti a breve di capitali internazionali stabilizzi i cambi. Come si rileva nella letteratura, oltre all'origine degli shock è importante nella speculazione il grado di flessibilità dei prezzi.

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PORTFOLIO BALANCE AND DYNAMIC STABILITY UNDER DUAL FLOATING EXCHANGE RATES

by
CHING-CHONG LAI and WEN-YA CHANG **

1. *Introduction*

It is widely recognized that the dual exchange rate regime has been one of the mechanisms utilized in many countries to relieve pressure on official reserves caused by massive shifts in speculative capital movements. According to 1988 *IMF Annual Report on Exchange Arrangements and Exchange Restrictions*, more than one-sixth of the member countries have engaged in dual currency practice. Under such a system, the current and the capital account are separated in that each is required to form its own market. The price in the current account market is usually called the *commercial* rate, and that in the capital account market is called the *financial* rate. Some countries fix the former while let the latter float; others let both float freely.

The existing studies of dual exchange markets almost unanimously focus their attention on the case of a one-fix-one-floating rate (see for example Flood, 1978; Cumby, 1984; Gardner, 1984; Dornbusch, 1986; and Lai and Chang, 1987, 1990a). It seems that very few efforts have been made in the literature to analyze the case of a dual floating exchange rate. Although Flood and Marion (1982), Bhandari (1985), Lai and Chu (1986), and Lai and Chang (1990b) have focused on the operation of a dual floating exchange rate system, all of these studies have missed the following point. Ascertaining whether a country is in a net creditor or is in a debtor position

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plays an important role in determining the dynamic properties of the economy. Thus, this note attempts to examine the relationship between the dynamic stability and the residents' net foreign asset position in the context of a dual floating exchange regime. The analysis indicates that the system will definitely exhibit total instability if the domestic country is a net foreign creditor, while it may be totally stable or totally unstable if the domestic country is a net foreign debtor.

2. *The Model*

The framework we shall use is a portfolio balance model developed by Kouri (1976) and Branson (1979) for a flexible exchange rate, and Gardner (1984) and Lai and Chang (1987) for a dual exchange rate. As in their system, the analysis is based on a number of simplifying assumptions: (1) domestic output is fixed at the full-employment level; (2) the world economy only produces a single traded good, the world price of which is given by the foreign economy because the domestic economy is small; and without loss of generality, this foreign currency price of the traded good is set at unity, meaning the domestic price level is equal to the commercial exchange rate as required by commodity arbitrage; (3) there are two assets held by domestic residents: domestic money and foreign bonds, and these assets are gross substitutes; (4) market participants form their expectations with perfect foresight; (5) the net supply of foreign bonds could be positive or negative as the domestic country is a net foreign creditor or debtor; (6) there is no investment and government purchase of traded goods.

In accordance with the above descriptions of the economy, the model of dual floating exchange rates can be expressed as follows:

$$M/p = k\,(pi^*/e + \dot{e}/e,\ M/p + eF/p), \qquad k_1 < 0,\ 0 < k_2 < 1 \quad (1)$$

$$y - c\,(y + i^*F,\ M/p + eF/p) + i^*F = 0, \qquad 0 < c_1 < 1,\ c_2 > 0 \quad (2)$$

where M = nominal money supply, p = domestic price level, k = real money demand, i^* = foreign interest rate, e = financial exchange rate (defined as the price of foreign currency in terms of domestic currency), F = domestic net private holdings of foreign bonds (denominated in foreign currency), y = full-employment output, c = domestic consumption demand, and an overdot indicates the rate of change with respect to time.

Equation (1) is the domestic money market equilibrium condition. The demand for real balance is specified in equation (1) as a decreasing function of the relative return between foreign bonds and domestic money, $pi^*/e + \dot{e}/e$ (see Lai and Chang, 1990b), and an increasing function of domestic real wealth. Due to the Walras law in the asset markets, one of the equilibrium conditions of two assets is redundant, therefore we do not explicitly specify the equilibrium condition for foreign bonds. Equation (2) is the equilibrium condition for the current account component of the foreign exchange markets. It states that the sum of the trade balance ($y - c$) and the service account (i^*F) must equal zero due to the fact that the commercial exchange rate is completely flexible to clear this market. Finally, one point which should be pointed out here is that F is unchanged over time since the financial exchange rate adjusts freely to clear the foreign exchange market for the capital account.

3. *Dynamic Stability*

We now turn to examine the dynamic properties of the model in the neighborhood of the steady state. At the long-run equilibrium, $\dot{e} = 0$, equations (1) and (2) together determine the steady-state value of the financial exchange rate, $\bar{e}$, and the commercial exchange rate (domestic price level), $\bar{p}$. Linearizing the system around the steady-state equilibrium and letting λ be the eigenvalue associated with the steady state, we have the following result:

$$\lambda = (i^*/\bar{e} - \bar{e}F/\bar{p}^2k_1)\,[\bar{p}M/(M + \bar{e}F)] \tag{3}$$

Obviously, the sign of λ crucially depends upon the value of the net foreign asset position (F). In what follows we shall focus our attention on the precise relationship between the dynamic properties and the value of F. Moreover, we assume that the residents' wealth ($M + eF$) is positive even if domestic economy is a net foreign debtor ($F < 0$).

First, if $F > 0$, from equation (3) it implies that the characteristic root λ is always greater than zero. Thus we have the following finding.

Finding 1. If the domestic country is in a net foreign creditor position, the regime of dual floating exchange rates cannot possibly display a totally stable equilibrium.

On the other hand, if $F < 0$ it follows from equation (3) that

$$\lambda = (\bar{p}i^*/\bar{e} - \bar{e}F/\bar{p}k_1)\,[M/(M + \bar{e}F)] \gtrless 0 \quad \text{as} \quad F \gtrless \bar{p}^2 i^* k_1/\bar{e}^2 \tag{4}$$

The above inequality tells us that: (i) the characteristic root *may* be positive if $F < 0$; (ii) the eigenvalue is associated with negative value unless F is sufficiently large in terms of absolute value. We therefore establish the following finding.

Finding 2. The system may be characterized with totally unstable equilibrium even if the domestic economy is in a net foreign debtor position. Unless the domestic residents possess an enormous debt, the domestic economy can be associated with total stability.

The economic explanation for the above two findings is as follows. Suppose the domestic country is a net foreign creditor and the domestic economy is at its steady state initially. Let us now investigate the effects of a small displacement of e from its steady-state value $\bar{e}$ in the upward direction. For the purpose of restoring current account equilibrium, it can be shown that p has to rise but in a less proportional way than e does (i.e., e/p has to increase). The increase in p and e/p will result in an excess demand for money, and $\dot{e} > 0$ is required to discourage people to hold domestic money. This indicates that a small displacement of e from its equilibrium level $\bar{e}$ in the upward direction will result in a further deviation from $\bar{e}$. We therefore conclude that the system is unstable in the neighborhood of the steady state.

On the other hand, if domestic residents possess a sufficiently large debt, it can be easily inferred that a small increase in e will lead to an excess supply of money; accordingly $\dot{e} < 0$ is required to bring demand and supply back to equilibrium again. Therefore, the system is stable since there exists an automatic mechanism to make e return to its steady-state value $\bar{e}$.

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SALDO DI PORTAFOGLIO E STABILITÀ DINAMICA CON CAMBI FLUTTUANTI

Si esamina la relazione tra stabilità dinamica e posizione netta delle attività estere dei residenti in un contesto di regime di cambi fluttuanti. L'analisi indica che il sistema mostra instabilità totale se il paese in esame è creditore netto sull'estero, mentre può essere totalmente stabile o totalmente instabile se il paese in esame è debitore netto sull'estero.

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A DYNAMIC MODEL OF EMPLOYMENT IN THE GREEK MANUFACTURING

by
NATASHA MIAOULI *

1. *Introduction*

The role of trade unions in wage and employment determination has been acknowledged by economists and policymakers alike. Greece is clearly not an exception. It is believed that the power of union members to raise the wage above reservation levels results mainly from the fact that they are not costlessly replaceable; that is, they are insiders in the sense of Lindbeck and Snower (1984). It is also known that union membership is not fixed over time but responds strongly to changes in past employment (Booth, 1983). Currently employed workers carry more weight in the wage setting process than the unemployed. There is a rich theoretical and empirical literature which attempts to use these insider dynamics to explain employment persistence (Blanchard and Summers, 1986; Kidd and Oswald, 1987; Alogoskoufis and Manning, 1988; and Nickell and Wadhwani, 1990). As a result, any employment decrease due to temporary shocks tends to perpetuate itself.

The present paper attempts two things. First, it introduces explicit dynamics into a monopoly union model. The extension is nontrivial because it allows us to specify conditions under which employment can converge to its full employment level. Second, it confronts the model with data from the Greek manufacturing during the period 1954-1989. This will enable us to identify the reasons for high employment persistence in the Greek labour market.

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Section II presents a monopoly union model, where union membership is a weighted average of those employed when wage contracts are signed (insiders) and the whole labour force. The main theoretical result is that saddlepath convergence to full employment requires that the union cares, not only about the insiders, but also about the unemployed. On the contrary, if only insiders matter to wage bargaining, employment displays full persistence (hysteresis) with no convergence to full employment. Therefore, the power of insiders in the union membership rule is a crucial factor to employment dynamics.

In Section III the model is confronted with data from the Greek Manufacturing. Combining the empirical findings with the theoretical predictions, we cannot reject the hypothesis that there is no room left for the unemployed workers in wage negotiations. Then, a high degree of employment persistence is attributed to the fact that wages are set with a view of ensuring jobs mainly to those currently employed, i.e. the insiders. Our estimations for the power of insiders are close to those of Blanchard and Summers (1986) for other European countries but higher than in Alogoskoufis and Manning (1988).

The policy message is clear. Measures for increasing the power of the unemployed can reduce the extremely high degree of employment persistence and hence increase the flexibility and adjustability of employment to negative shocks (see also Emerson, 1988; Bentolila and Bertola, 1990; and Bentolila and Saint-Paul, 1992 for analogous policy recipes).

Finally, Section IV closes the paper and discusses possible extensions.

II. *The Theoretical Model*

We keep the theoretical model as simple as possible. In a monopoly union context, the labour market consists of a representative firm and a trade union. The market operates at discrete and similar periods. Each time t, nominal wages (w_t) are chosen by the trade union, before the realization of the exogenous price level (p_t) becomes known. Then, employment (ℓ_t) is ex-post chosen by perfectly competitive firms.

Consider the formal scenario. Under complete current information, the demand for labour is given by [1]

$$\ell_t = -\delta\,(w_t - p_t) \tag{1}$$

[1] Since we want to focus on membership dynamics, we abstract the adjustment costs from the point of view of firms.

where, $\delta > 1$ by the properties of a decreasing returns to scale technology. All variables will be in logs.

The exogenous price level is assumed to follow a random walk [2]

$$p_t = p_{t-1} + u_t \tag{2}$$

where, u_t is a white noise disturbance with the standard properties.

Each period t, union members (m_t) choose nominal wages (w_t) so as to keep their jobs from period t onwards (see Oswald, 1986; and Kidd and Oswald, 1987) [3]

$$\min_{w_t} E_{t+i}\left\{\sum_{i=0}^{\infty} \gamma^i [1/2\, (\ell_{t+i} - m_{t+i})^2]\right\} \tag{3}$$

where, $0 < \gamma < 1$ is a nonstochastic discount factor [4]. E_t denotes rational expectations conditional on the available information set at time t, which includes all variables up to and including period $t-1$. Thus, current variables are not observable by union members when they choose w_t.

The last step is to define union membership (m_t). Following Blanchard and Summers (1986) and Lindbeck and Snower (1989), we assume that m_t is a weighted average of those employed when the nominal wage contract is signed (ℓ_{t-1}) and of the current whole labour force (ρ_t). Thus, with $0 \leq \alpha \leq 1$

$$m_t = \alpha \ell_{t-1} + (1 - \alpha)\, \rho_t \tag{4}$$

In the case where $\alpha = 1$, all the unemployed as well as new entrants are considered as outsiders [5]. In the case where $\alpha = 0$, everybody is an insider and the model is a natural-rate one as in Gray (1976) and Fischer (1977).

The exogenous labour force (ρ_t) is assumed to follow a random walk process

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[2] Assuming other processes would not affect any of our results.

[3] We could assume more complicated objectives for union members (for instance, that they dislike price inflation or have a real wage target). However, this would not affect our main results. See Blanchard and Fischer (1989).

[4] Quadratic functions are of particular interest in economic and game theory, first because they constitute second-order approximations to other types of non-linear functions and secondly because they are analytically tractable admitting in general closed-form equilibrium solutions.

[5] A rationale for this membership rule is the assumption that workers remain insiders for some time after losing their jobs. The reason unions encourage the unemployed to remain in the union appears to be due in part to their desire to increase membership figures, and through these, their role in the national union movement.

$$\rho_t = \rho_{t-1} + v_t \tag{5}$$

where v_t is a white noise disturbance.

Equations (1)-(5) complete the structure of the model [6]. Optimal behaviour by union members and the use of (1) lead to the following Euler equation [7].

$$\alpha\gamma E_{t+i}\ell_{t+i+1} - (1+\alpha^2\gamma)\, E_{t+i}\ell_{t+i} + \alpha\ell_{t+i-1} + \\ + (1-\alpha)(1-\alpha\gamma)\, \rho_{t+i-1} = 0 \tag{6}$$

where, the statistical structure and the information set imply $E_{t+i}\rho_{t+i} = = \rho_{t+i-1}$ and $E_{t+i}p_{t+i} = p_{t+i-1}$ for $i \geq 0$.

In what follows, I shall examine the dynamic evolution of employment given by (6). Starting from the steady state, (6) implies that as $t \rightarrow \infty$, then $\ell^\infty = \rho^\infty$. In other words, in the long-run the whole labour force will be employed [8]. The next step is to check the evolution of employment toward this well-behaved steady state. The rest of the section follows Sargent (1987).

Using the lag operator $L^i\ell_t \equiv \ell_{t-i}$, we write (6) as [9]

$$\alpha\gamma\left(1 - \frac{1+\alpha^2\gamma}{\alpha\gamma}L + \frac{1}{\gamma}L^2\right)\ell_{t+i+1} + (1-\alpha) \\ + (1-\alpha\gamma)\,\rho_{t+i-1} = 0 \tag{7}$$

where $\left(1 - \frac{1+\alpha^2\gamma}{\alpha\gamma}L + \frac{1}{\gamma}L^2\right) = (1-\lambda_1 L)(1-\lambda_2 L) = 1 - (\lambda_1 + + \lambda_2)L + \lambda_1\lambda_2 L^2$

We now solve for the two roots in the above factorization (say, λ_1 and λ_2). Let $\lambda_1 = \alpha$ and $\lambda_2 = 1/\alpha\gamma$. In the general case where the unemployed workers matter to wage bargaining, i.e. $\alpha < 1$, it follows that $\lambda_1 = \alpha < 1$ is the stable root and $\lambda_2 = 1/\alpha\gamma > 1$ is the unstable root.

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[6] It is clear that here we do not examine strategic interactions between the trade union and firms as in PLOEG (1987), or between the trade union and policymakers as in BARRO and GORDON (1983). Instead, we focus on mechanical dynamics, since the aim is to study the (theoretical and empirical) implications of union membership for employment dynamics.

[7] This condition is also sufficient if it satisfies the initial and transversality condition (see below).

[8] This is what one should expect: in the long-run it is optimal for employment to "settle-down".

[9] Here, for notational simplicity, we drop the expectations operator.

Imposing saddlepath stability, we solve the stable root (λ_1) backward [10] and the unstable root (λ_2) forward. Then, operating on both sides of (7) with the forward inverse of $(1 - \lambda_2 L)$, we get for $i \geq 0$ and $j \geq 0$

$$(1 - \alpha L)\,\ell_{t+i+1} = \frac{(1-\alpha)(1-\alpha\gamma)}{\alpha\gamma} \sum_{j=0}^{\infty} (\alpha\gamma)^{j+1} E_{t+i-1}\rho_{t+i+j} + c\left(\frac{1}{\alpha\gamma}\right)^{t} \tag{8}$$

where c is a constant.

We can simplify (8) in three ways. First, for $i, j \geq 0$, we have $E_{t+i-1}\rho_{t+i+j} = \rho_{t+i-1}$. Second, since $(\alpha\gamma) < 1$, we have $\sum_{j=0}^{\infty} (\alpha\gamma)_{j+1} = = \frac{\alpha\gamma}{(1-\alpha\gamma)}$. Third, since $\lim_{t\to\infty}\left(\frac{1}{\alpha\gamma}\right)^{t} = +\infty$, we have to set $c = 0$ (together with the use of the unstable root λ_2 to solve forward, this satisfies the transversality condition).

Using all the above and showing that (8) holds for $i \geq -1$ as well, we finally get the saddlepath solution for employment

$$\ell_{t+i} = \alpha\ell_{t+i-1} + (1-\alpha)\,\rho_{t+i-1} \qquad \text{for } i \geq 0 \tag{9}$$

where now everything is in terms of observables.

According to (9), employment is a function of once-lagged employment and the exogenous labour force. Comparing the final saddlepath solution (9) with the membership rule (4), the similarity is striking. This is not surprising since in our model union members, as defined in (4), can hit their employment target exactly conditional on the information set. However, the present solution is nontrivial because (9) has excluded the unstable root.

Current employment depends on previous period employment with the degree of persistence given by the power of insiders in the union membership rule ($0 \leq \alpha \leq 1$). This first-order difference equation implies that over time current employment is expected to become less dependent on the initial group of those employed (ℓ_{t-1}) and more dependent on the whole labour force until $\ell^{\infty} = \rho^{\infty}$.

Observe that in the special case where union members care only about those currently employed ($\alpha = 1$), the model does not have well-behaved dynamics. In particular, the steady state cannot be defined (any

[10] Since $\lambda_1 = \alpha < 1/\sqrt{\gamma}$ the transversality condition is satisfied.

current employment rate can become the equilibrium or steady state rate) and additionally the model is globally unstable (both roots are outside the unit circle, $\lambda_1 = 1$ and $\lambda_2 = 1/\gamma > 1$). This is the popular case of full persistence of hysteresis in employment: since insiders always set wages to protect only their jobs, any level of employment may be self-perpetuating [11].

Let us summarize. Rational behaviour by union members can place employment on its unique convergent path towards its steady state, which is the level of full employment. Such a saddlepath stability is possible if there is some room left for the unemployed workers in wage negotiations ($0 \leq \alpha < 1$).. On the contrary, if only insiders matter to wage bargaining ($\alpha = 1$), employment displays full persistence (hysteresis).

The above make clear that the power of insiders in the union membership rule (4) is the crucial factor to employment dynamics. Hence, our next task is to identify the value of the parameter α for the Greek labour market. This is attempted in the next section, where the Euler condition (6) is confronted with data from the Greek Manufacturing.

III. *Empirical Results*

The empirical work makes use of annual data on employment in the Greek Manufacturing during the period 1954-1989, which is the longest period available. (The data sources are given in the Appendix).

The choice of this particular sector, i.e. manufacturing, was mainly determined for two reasons. First, there are sufficient and relatively reliable data which allow a thorough investigation of wages and employment. Second, Greek manufacturing is spread among several regions in the country and is not as heavily concentrated in a few parts of Greece; it therefore characterizes the whole labour market. In other words, the implications for employment and wages which emerge from the analysis of the Greek manufacturing can be generalized for the whole labour force of the private sector without many risks.

I proceed now in the estimation of (6). Assuming, without any loss of generality, that the exogenous labour force (ρ) is constant, it can be rewritten as

[11] See BLANCHARD and SUMMERS (1986). In the presence of an adverse unanticipated shock which reduces employment, some workers become disfranchised. The new smaller group of insiders sets the wage so as to permanently maintain this new lower level of employment causing consequently serial correlation to employment. This leads to lower expected employment in all subsequent periods even though wages are chosen anew.

$$\ell_t = \ell_0 + \rho_1 \ell_{t-1} + \rho_2 \ell_{t-2} + \varepsilon_t \tag{10}$$

where, ℓ_0 is a constant, $\rho_1 \equiv \dfrac{1 + \alpha^2\gamma}{\alpha\gamma} = (\lambda_1 + \lambda_2)$ and $\rho_2 \equiv -\left(\dfrac{1}{\gamma}\right) =$ $= -(\lambda_1\lambda_2)$. Finally, ε_t is a white noise process justified by the presence of expectations in (6).

TABLE 1

LS ESTIMATES OF EMPLOYMENT EQUATION 1958-1989

	Dependent variable (ℓ_t)
c	0.388
	(0.236)
ℓ_{t-1}	1.51
	(0.15)
ℓ_{t-2}	− 0.61
	(0.15)
t	0.002
	(0.001)
R^2	0.994
S	0.018
AUT (1)	0.195
LIN (1)	2.378
HET (2)	6.868
ARCH (1)	0.445

NOTES: See the Appendix for data definitions, sources and details about estimation and testing. Standard errors in parentheses.

Table 1 presents the first informal evidence relating to the employment equation (10). The current level of employment turns out to be related to the levels observed over the previous two periods with a degree of persistence $(\rho_1 + \rho_2) = 0.85$. Here $(\rho_1 + \rho_2)$ is a measure of persistence in the broad sense of "continuing for a long time into the future", as in Campbell and Mankiw (1987). In other words, the data hint that the original series ℓ_t is nonstationary.

We can now become more formal by using the standard augmented Dickey-Fuller test for unit roots. This involves rewriting (10) as

$$\Delta\ell_t = \ell_0 + (\rho_1 + \rho_2 - 1)\,\ell_{t-1} - \rho_2\Delta\ell_{t-1} + \varepsilon_t \tag{11}$$

which, gives a regression of $\Delta\ell_t \equiv (\ell_t - \ell_{t-1})$ on ℓ_{t-1} and $\Delta\ell_{t-1}$.

We have seen in the theoretical model above that the two roots are $\lambda_1 = \alpha$ and $\lambda_2 = 1/\alpha\gamma$. We have also proved that if only insiders matter to wage bargaining ($\alpha = 1$), the model does not have well-behaved employment dynamics. Observe now that if $\alpha = 1$, $\rho_1 = 1 + 1/\gamma$, $\rho_2 = -(1/\gamma)$ and hence $(\rho_1 + \rho_2) = 1$. Therefore, the coefficient on ℓ_{t-1} in (11) will allow us to test for employment stability: by testing $(\rho_1 + \rho_2) = 1$, we test the null hypothesis that $\alpha = 1$.

Results of the Dickey-Fuller tests for $(\rho_1 + \rho_2) = 1$, are reported in Table 2. The relevant t-statistic is $|1.33|$ and hence the hypothesis that

TABLE 2

TEST FOR AUTOREGRESSIVE UNIT ROOTS IN EMPLOYMENT (ℓ_t)
1957-1989

Series	DF	ADF	
	ℓ_{t-1}	ℓ_{t-1}	$\Delta\ell_{t-1}$
ℓ_t	− 0.01 (0.20)	− 0.08 (1.33)	0.60 (3.92)

NOTES: MacKinnon critical values: 5% level = − 3.54, 1% level = − 4.25.
Also, $\Delta\ell_t \equiv \ell_t - \ell_{t-1}$ t-statistics in parentheses.

$\alpha = 1$ cannot be rejected at either 5% or 1% levels. Therefore, the employment series is integrated of order 1 I (1) [12]. This finding is consistent with the employment patterns of other European countries (see Newell and Symons, 1985; Bean, Layard and Nickell, 1986; and Alogoskoufis and Manning, 1988).

Let us summarize. Combining the empirical results with the theoretical analysis, we cannot reject the hypothesis that $\alpha = 1$ (results are reported in Table 3). In other words, we cannot reject the hypothesis that only insiders matter to wage bargaining, which in turn implies that the path of employment over time is globally unstable.

Employment hysteresis in the Greek manufacturing can be attributed to the fact that wages are set with a view of ensuring jobs mainly to those currently employed, i.e. the insiders. Outsiders do not seem to play any important role and this makes the dynamic process of employment unstable. Finally, it is interesting that our estimations for α are close to the estimates

[12] I have also checked the hypothesis that ℓ_t is $I(2)$ and it is not accepted.

TABLE 3

LS ESTIMATES OF EMPLOYMENT EQUATION 1058-1989

Dependent variable ($\Delta \ell_t$)	
c	0.007
	(0.004)
$\Delta \ell_{t-1}$	0.55
	(0.15)
R^2	0.991
S	0.018
AUT (1)	0.023
LIN (1)	5.700
HET (2)	11.25
ARCH (1)	0.072

NOTES: See the Appendix for data definitions, sources and details about estimation and testing. Standard errors in parentheses.

of Blanchard and Summers (1986) for other European countries but higher than those of Alogoskoufis and Manning (1988).

IV. *Conclusions and Possible Extensions*

This paper has explicitly analyzed the dynamic behaviour of employment in the Greek manufacturing. The driving force has been an optimizing trade union whose members change over time. The main theoretical result is that employment can converge to its full employment level only if union members take into account, not only the interests of the insiders, but also the interests of the unemployed. However, confronting the theoretical predictions with the data, we cannot reject the hypothesis that only insiders matter to wage bargaining. This makes the dynamic process of employment unstable.

The policy message is clear and not surprising. Measures for increasing the power of the unemployed can reduce the extremely high degree of employment persistence and hence increase the flexibility and adjustability of employment to negative shocks (see also Emerson, 1988; Bentolila and Bertola, 1990; and Bentolila and Saint-Paul, 1992).

We close with some possible empirical extensions. It would be interesting to introduce capital accumulation and hence interactions between firms and union members as in Ploeg (1987), and then test how the presence of the capital stock affects employment and wage determination. Another possible extension of the model would be to examine the influence of stabilization programs and the political business cycle on employment or wage determination.

APPENDIX: DATA DEFINITIONS AND DIAGNOSTICS

ℓ : the logarithm of manufacturing employment. Source: IFS.

R^2 : the coefficient of determination.

S : standard error of the regression.

Aut (1) : the RESET type test for autocorrelation, based on an auxiliary regression of the residuals on one lag of the residuals, and on the fitted values. Its asymptotic distribution is X^2.

Lin (1) : the RESET type test for departures from linearity, based on an auxiliary regression of the residuals on the level and square of fitted values. Its asymptotic distribution is X^2.

Het (2) : the RESET type test for departures from homoskedasticity, based on an auxiliary regression of the squared residuals on the fitted values and their squares. Its asymptotic distribution is X^2.

ARCH (1): the Autoregressive Conditional Heteroskedasticity test, based on an auxiliary regression of the squared residuals on lagged squared residuals. Its asymptotic distribution is X^2.

Basmann : the test for overidentifying restrictions, based on an auxiliary regression of the residuals on all the instruments. This is an F-type test.

Chow : the test of the stability of the regression coefficients based on LS estimates of two different sample periods. This is an F-type test.

The degrees of freedom for the statistics are in parenthesis. For the statistical theory underlying these diagnostics see Spanos (1986).

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UN MODELLO DINAMICO DI OCCUPAZIONE PER L'INDUSTRIA MANUFATTURIERA GRECA

L'articolo usa un modello di sindacato monopolistico con una dinamica endogena di associazione per identificare le ragioni dell'alta persistenza dell'occupazione nel mercato del lavoro in Grecia. La stabilità del tipo punto di sella richiede che il sindacato si preoccupi non soltanto dei lavoratori che sono occupati al momento (interni) ma di tutta la forza lavoro. Se, al contrario, non si preoccupa degli esterni, la dinamica dell'occupazione non si comporta bene. Combinando le previsioni teoriche con i risultati empirici non possiamo respingere l'ipotesi che l'elevata persistenza dell'occupazione sia dovuta al fatto che gli esterni sono esclusi dalla contrattazione salariale.

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QUARTERLY DISAGGREGATION OF THE ANNUALLY KNOWN GREEK GROSS INDUSTRIAL PRODUCT USING RELATED SERIES

by
DIKAIOS E. TSERKEZOS *

1. *Introduction*

Empirical analysis of certain countries and historical periods is often curtailed by the lack of data sufficiently disaggregated with regard to time. By choosing annual data because no quarterly are available, we do not only lose efficiency of estimates due to loss of information, but also we are likely to have specification errors. This would lead to biases [1] in the parameter estimates – biases from what we expect theoretically for parameter change due to aggregation over time.

This is the case in Greece where quarterly data for only some basic macroeconomic variables are available after the first quarter of 1975. So it is impossible to carry out any interesting applied work on quarterly basis before that date.

In this paper following a related series "missing" data approach we attempt [2] to generate quarterly figures of the annually known gross product of the industrial sector of the Greek economy in a dynamic quarterly relationship. Our approach is a missing data technique similar to that of Sargan-Drettakis (1974), Gilbert (1977) and Tserkezos (1989a), following an approach suggested by Anderson (1957). We treat the "missing" quarterly

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[1] MORIGUCHI (1970, pp. 427-28).

[2] Several methods were devised to deal with the problem of constructing quarterly data according to whether (a) related series are available or (b) only annual totals exist. For more, see BOOT, FEIBES and LISMAN (1967), CHOW and LIN (1971), FRIEDMAN (1962), DENTON (1971), GINSBURG (1973), FERNADEZ (1981), STRAM and WEI (1986), and more recently HARVEY (1981b, 1989), and HARVEY and PIERCE (1984).

(gross industrial product) observations as unknown parameters which have to be estimated simultaneously with the other parameters of a geometric distributed lag model (in which the under disaggregation variable is the dependent one) taking into account the available annual observations and the appropriate [3] functional and stochastic specification between the dependent and the independent variable(s).

Recently an interesting approach to deal with the time disaggregation problem is the Kalman Filter approach (Harvey, 1981a, 1981b, 1989; and Harvey and Pierce, 1984). The approach we follow in this article is simpler and less computationally expensive than the Kalman Filter approach. In our approach, we simply use standard regression packages (*TSP, RATS, SPSS,* etc.) after substituting the under disaggregation variable by appropriate approximations, for estimating and testin the dynamic model which we assumed to explain the behaviour of the under time disaggregation variable.

This paper is organized as follows. In Section 2 we present the under estimation specification and the suggested disaggregation technique. In Section 3 we give some of the results based on the application of the suggested technique trying to generate quarterly figures of the gross product of the industrial sector of the Greek economy (*QVINDC*) for the period 1963.I - 1974.IV using as independent variable the quarterly index of industrial production (*QPRIM*). Finally, Section 4 offers some concluding remarks.

2. *The Model and the Time-Disaggregation Technique*

The missing data technique will be presented through the use of the following geometric [4] distributed lag model involving the flow variables:

$$QVINDC_t = \alpha + \sum_{j=0}^{00} b_j \, QPRIM_{t-j} + \sum_{j=1}^{4} (q_j + d_j \, TR_t) \, Q_{tj} + u_t + u_t$$

$$t = 1, 2, ..., T. \qquad t = 1, 2, ..., T. \qquad (2.1)$$

with

$$b_j = bv_j \qquad (2.2)$$

$$v_j = (1 - \lambda) \lambda^j, \quad \Sigma v_j = 1 \quad 0 < \lambda < 1$$

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[3] See Gamaletsos (1973, pp. 267-89).

[4] Davidson, Hendry, Sbra and Yeo (1978, pp. 669-70). It should be pointed out that at the moment in Greece there are not many available time series on a quarterly basis to be used as independent variables in the model (2.1).

$QVINDC_t$ = Quarterly [5] gross product of the industrial sector of the Greek economy, at 1970 constant prices
$QPRIM$ = Quarterly index of industrial production, branches 20-39 and base 1970 = 100
Q_{tj} = Seasonal dummy variables
TR_t = Long-run trend for $t = 1, 2, 3, ..., T$
u_t = Random disturbance term having the property

$$u_t \sim NID(0, \sigma^2).$$

Using Klein's suggestion [6] to estimate distributed lag models, the model (2.1) - (2.2) can be written in matrix form as:

$$y = x(\lambda)\, w + u \tag{2.3}$$

with

$$x(\lambda)' = [x_1' \; x_2' \; x_3' \; ... \; x_T') \tag{2.4}$$

$$x_t = [1 \; Z_{t2} \; Z_{t1} \; Q_{t1} \; Q_{t2} \; Q_{t3} \; Q_{t4} \; Q_{t1}TR_t \; Q_{t2}TR_t \; Q_{t3}TR_t \; Q_{t4}TR_t] \tag{2.5}$$

$$n_0 = E(QVINDC_0) = (1 - \lambda) \sum_{j=0}^{00} \lambda^j \, QPRIM_{-j} \tag{2.6}$$

(initial-value parameter)

$$Z_{t2} = (1 - \lambda) \sum_{j=0}^{t-1} \lambda^j \, QPRIM_{t-j} \tag{2.7}$$

$$Z_{t1} = \lambda^t$$

$$w' = (a \; \delta) \tag{2.8}$$

$$a' = (\alpha \; b \; n_0) \tag{2.9}$$

$$\delta' = (q_1 \; q_2 \; q_3 \; q_4 \; d_1 \; d_2 \; d_3 \; d_4) \tag{2.10}$$

$$Q_{tj} = \begin{bmatrix} 1, \text{ if } t \text{ is a time point associated with the first quarter} \\ 0, \text{ otherwise} \end{bmatrix} \tag{2.11}$$

$$u' = (u_1 \; u_2 \; u_3 \; ... \; u_T) \tag{2.12}$$

$$E(u) = 0$$

[5] All the variables in this paper are seasonally unadjusted.
[6] HARVEY (1981a, pp. 237-39) and GAMALETSOS (1973, pp. 251-53).

$$V(u) = \sigma_u^2 I_T \tag{2.13}$$

$$E(x(\lambda)' u) = 0$$

$$u \sim \text{N.I.D.}\ (0, \sigma_u^2 I_T) \tag{2.14}$$

and

$y = (T \times 1)$ vector of the dependent variable (quarterly gross product of the industrial sector at 1970 constant prices).

According to the available annual and quarterly data in the case of the Greek economy we assume that over the first T_1 quarters only annual observations are available on y (*QVINDC*). We define $T_2 = T - T_1$ and for algebraic convenience we assume that $(T_1/4)$ is an integer. We split the specification (2.3) as:

$$\begin{bmatrix} y_1^Q \\ y_2^Q \end{bmatrix} = \begin{bmatrix} x_1^Q(\lambda) \\ \hline x_2^Q(\lambda) \end{bmatrix} w + \begin{bmatrix} u_1^Q u_2^Q \end{bmatrix} \tag{2.15}$$

where y_1^Q is a $T_1 \times 1$ vector giving the first T_1 (quarterly) observations on y, etc.

In the suggested time disaggregation approach we estimate simultaneously the under estimation parameters w and the "missing" under disaggregation quarterly observations y_1^Q taking into account all the available information (i.e. the existing by assumption $(T_1/4)$ annual observations on y). This approach is suggested by Anderson (1957) and further extended by Sargan-Drettakis (1974), Gilbert (1977) and Tserkezos (1989a). This states that under normality of the residuals of (2.3) we may treat the y_1^Q "missing" under time disaggregation quarterly observations of the gross industrial product as unknown parameters which have to be estimated simultaneously with the other parameters (w) of the quarterly model (2.15) taking into account the available annual observations (if they are available).

By minimizing the sum of squares function

$$F = (y^m - x(\lambda)\, w)'\, (y^m - x(\lambda)\, w) \tag{2.16}$$

where

$$y^m = \begin{bmatrix} y_1^Q \\ y_2^Q \end{bmatrix}$$

with respect to y_1^Q and the unknown parameters w taking into account the annual available information on y_1^Q formulated by the relation:

$$Cy_1^Q = y_1^A \tag{2.17}$$

(y_1^A : $(T_1/4)$ annual available observations of y)

If the model is correctly specified, we obtain consistent [7] and asymptotically efficient estimators of the "missing" (quarterly) observations y_1^Q and the parameters of the under estimation (quarterly) specification (2.3).

The matrix C is a $(T_1/4 \times T_1)$ aggregation [8] matrix of the form:

$$C = \begin{bmatrix} 11110000............0000 \\ 00001111............0000 \\ 000000001111....0000 \\ \\ 00000000............1111 \end{bmatrix} \tag{2.18}$$

We are able to prove (Appendix A) that this minimization procedure leads to the following disaggregated data estimator:

$$\hat{y}_1^Q = \bar{y}_1 + (x_1^Q(\lambda) - \bar{x}_1(\lambda))\, w \tag{2.19}$$

with

$$\bar{y}_1 = C'(CC')^{-1} Cy_1^Q \tag{2.20}$$

$$\bar{x}_1(\lambda) = C'(CC')^{-1} Cx_1^Q(\lambda) \tag{2.21}$$

Thus, given λ and conditional upon the estimated vector of coefficients w, we may estimate the (T_1) disaggregeted quarterly observations y_1^Q by adding to the (T_1) observed quarterly averages y_1 the (T_1) weighted (with the estimation vector w) deviations of the explanatory variables $x_1^Q(\lambda)$ from their quarterly averages $\bar{x}_1(\lambda)$, i.e. $(x_1^Q(\lambda) - \bar{x}_1(\lambda)$.

The relation (2.19) can be written as:

$$\hat{y}_1^Q - x_1^Q(\lambda)\, w = \bar{y}_1 - \bar{x}_1^Q(\lambda)\, w \tag{2.22}$$

which is substituted indo the unconstrained Sum of Squares function (2.16) to obtain:

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[7] SARGAN and DRETTAKIS (1974, p. 39).

[8] For more about these Time-Aggregation relations using matrix approach, see: GILBERT (1977, pp. 223-25) and TSERKEZOS (1989a, pp. 375-78).

$$\bar{F} = \bar{y}_1 - x_1(\lambda)\,\bar{w})'\,(\bar{y}_1 - x_1(\lambda)\,\bar{w}) + \\ + (y_2^Q - x_2^Q(\lambda\, w)'\,(y_2^Q - x_2^Q(\lambda)\,w) \qquad (2.23)$$

which is immediately recognized as the function that, given λ, is minimized by ordinary least squares estimation of equation (2.15) after replacing both the disaggregated quarterly observations y_1^Q and the corresponding values of the exogenous variables x_1^Q by their quarterly averages $\bar{y}_1$ and $\bar{x}_1(\lambda)$ respectively.

The specification (2.15) may be estimated directly using standard regression packages (*TSP, RATS, SPSS*, ... etc.); for given values of λ what is required is the replacement of both the missing quarterly data and the corresponding values of the exogenous variables by their quarterly averages. Of course, degrees of freedom correction will be necessary.

3. *Quarterly Estimates of the Gross Industrial Product*

Assuming that quarterly data for the domestic gross industrial product are not available for the subperiod 1975.I, ..., 1979.IV, we applied the "missing" data technique to estimate the parameters of the specification (2.3) and the time disaggregated observations in order to make comparisons with the already existing actual quarterly data.

Using relation (2.22) on the basis of specification (2.1), we obtained the estimates of specification (2.3) and the "missing" under time disaggregation quarterly data for the subperiod T_1 = 1975.I, ..., 1978.IV (Table 1).

In order to compare the disaggregated quarterly data with the actual ones using some well known techniques, we expressed the variables of Table 1 as relative (percentage) changes, i.e.

$$p_t = \left(\frac{FQVINDC_t - QVINDC_{t-1}}{QVINDC_{t-1}}\right) \qquad a_t = \left(\frac{QVINDC_t - QVINDC_{t-1}}{QVINDC_{t-1}}\right)$$

with

p_t = Disaggregated relative percentage changes
a_t = Actual relative percentage changes

and

$e_t = p_t - a_t$ (Error of relative percentage changes)

A graphical presentation of the actual and the disaggregated quarterly

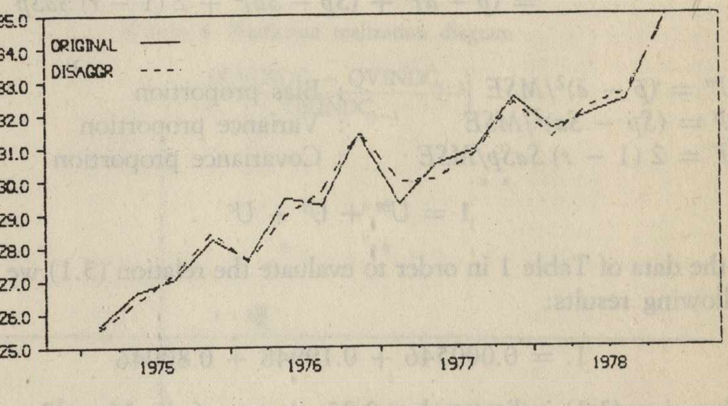
TABLE 1

ACTUAL AND DISAGGREGATED QUARTERLY DATA FOR THE GREEK GROSS INDUSTRIAL PRODUCT (Period 1975.I, ..., 1978.IV).
Billion drachmae at 1970 prices

	Actual	Disaggregated		Actual	Disaggregated
	QVINDC	*FQVINDC*		*QVINDC*	*FQVINDC*
1975: 1	25.6480	25.5466	1977: 1	29.2580	29.9419
1975: 2	26.6310	26.3857	1977: 2	30.5170	30.0290
1975: 3	27.0550	27.2025	1977: 3	30.9570	30.8759
1975: 4	28.2020	28.4011	1977: 4	32.4920	32.3772
1976: 1	27.5820	27.5529	1978: 1	31.5530	31.2901
1976: 2	29.4370	28.9335	1978: 2	32.0240	32.2260
1976: 3	29.2090	29.6800	1978: 3	32.4520	32.6559
1976: 4	31.3720	31.4336	1978: 4	34.9420	34.7990

Source: *QVINDC*: Quarterly National Accounts of Greece. *FQVINDC*: Author's Estimates.

FIGURE 1. Actual and disaggregated *QVINDC* of the Greek economy (billion drachmae at 1970 prices).



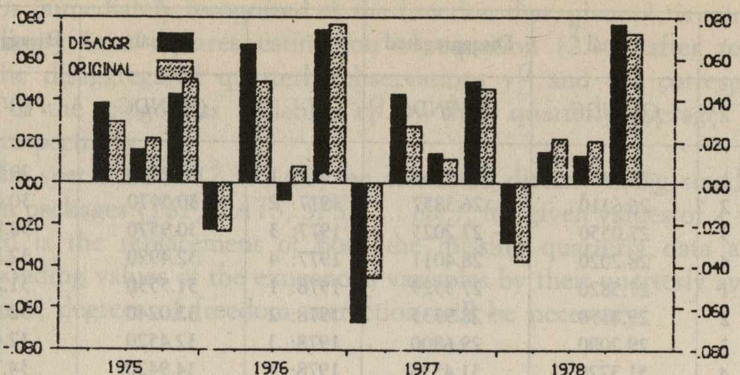
observations as levels and as relative percentage changes are given in Figs. 1 and 2 respectively.

A quantitative measure of the forecast error e_t is the Mean Square Error [9] which can be easily mathematically decomposed into three constit-

[9] For more see MADDALA (1977, pp. 343-47).

FIGURE 2. Actual and disaggregate *QVINDC* of the Greek economy (billion drachmae at 1970 prices).

Variables as relative percentage changes



uent elements, each of which has a very distinct interpretation. In mathematical terms this decomposition [10] can be written in the following way:

$$MSE = ((1/(T-1)) \sum_{t=2}^{T} (p_t - a_t)^2) = U^m MSE + U^s MSE + U^c MSE$$

$$= (\bar{p} - \bar{a})^2 + (Sp - Sa)^2 + 2\,(1 - r)\, SaSp \qquad (3.1)$$

and

$U^m = (\bar{p} - \bar{a})^2/MSE$: Bias proportion
$U^s = (Sp - Sa)^2/MSE$: Variance proportion
$U^c = 2\,(1 - r)\, SaSp/MSE$: Covariance proportion

$$1 = U^m + U^s + U^c \qquad (3.2)$$

Using the data of Table 1 in order to evaluate the relation (3.1) we obtain [11] the following results:

$$1. = 0.000546 + 0.19948 + 0.80046 \qquad (3.3)$$

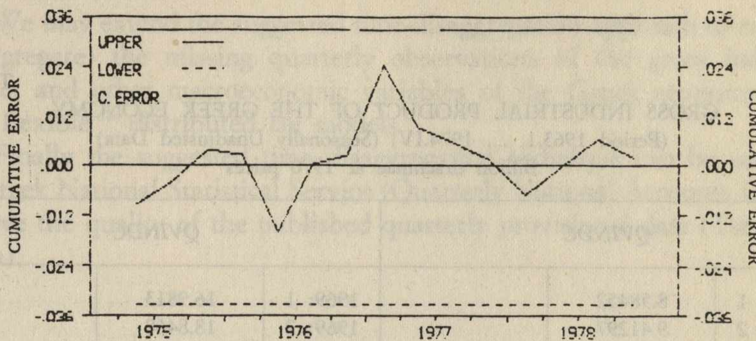
Equation (3.3) indicates that 0.05 percent of the Mean Square Error results from bias, 19.9 percent from errors of variation and 80 percent from

[10] $\bar{p}$, $\bar{a}$: Means p_t and a_t.
Sp, Sa: Standard Deviations of p_t and a_t.
r: Correlation coefficient of p_t and a_t.
[11] Theil's Inequality coefficient U_{66} was 0.23786.

less than perfect correlation of actual and predictive values. The small bias component tends to confirm the conclusion that there is no persistence tendency to incorrectly estimate the magnitude percentage changes of the dependent variable.

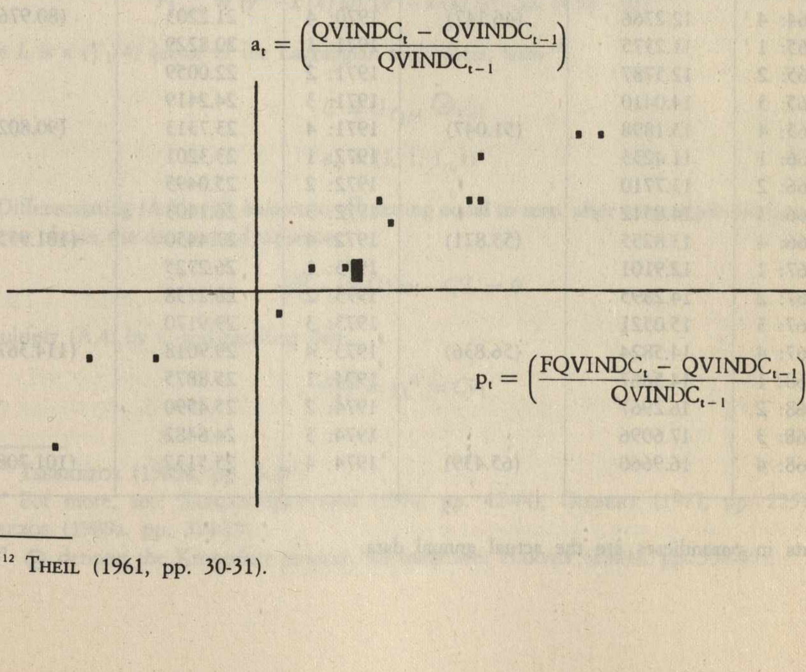
In relation with the above analysed criteria in Fig. 3 and 4 we give the Control-Chart and the Prediction-Realization Diagram [12]. Examining the

FIGURE 3. Control chart of error of relative percentage changes.



−U−U−U− = UPPER LIMIT L−L−L−L− = LOWER LIMIT

FIGURE 4. Prediction realization diagram



[12] THEIL (1961, pp. 30-31).

scatter diagram we see the obvious correlation between the observed and the forecasted behavior. Out of 15 quarterly observations the direction of change of the dependent variable was correctly forecasted 14 times.

Using relation (2.22) on the basis of specification (2.1) we obtained the disaggregated quarterly observations of the gross industrial product of the Greek economy for the subperiod T_1 = 1963.I, ..., 1974.IV (Table 2).

Using the aggregation matrix C it is not difficult to see that the quarterly estimates of Table 2 are consistent with the annual observations of that period.

TABLE 2

GROSS INDUSTRIAL PRODUCT OF THE GREEK ECONOMY.
(Period 1963.1, ..., 1974.IV) (Seasonally Unadjusted Data)
Billion drachmae at 1970 prices

QVINDC			*QVINDC*		
1963: 1	8.58452		1969: 1	16.9813	
1963: 2	9.41297		1969: 2	18.8468	
1963: 3	11.4336		1969: 3	19.4899	
1963: 4	10.9469	(40.387)	1969: 4	19.6209	(74.939)
1964: 1	9.94259		1970: 1	18.3702	
1964: 2	10.8830		1970: 2	19.8309	
1964: 3	13.0448		1970: 3	21.5546	
1964: 4	12.2766	(46.147)	1970: 4	21.2203	(80.976)
1965: 1	11.2375		1971: 1	20.8229	
1965: 2	12.5787		1971: 2	22.0059	
1965: 3	14.0410		1971: 3	24.2419	
1965: 4	13.1898	(51.047)	1971: 4	23.7313	(90.802)
1966: 1	11.4233		1972: 1	23.3201	
1966: 2	13.7710		1972: 2	25.0495	
1966: 3	14.8512		1972: 3	26.1403	
1966: 4	13.8255	(53.871)	1972: 4	27.4450	(101.955)
1967: 1	12.9101		1973: 1	26.2725	
1967: 2	14.2895		1973: 2	28.2758	
1967: 3	15.0521		1973: 3	29.9170	
1967: 4	14.5824	(56.836)	1973: 4	29.9018	(114.367)
1968: 1	14.5667		1974: 1	25.8875	
1968: 2	16.2967		1974: 2	25.4590	
1968: 3	17.6096		1974: 3	24.8482	
1968: 4	16.9660	(65.439)	1974: 4	25.5132	(101.708)

* Data in parentheses are the actual annual data.

4. *Conclusions*

In this study following a well known "related series missing data" approach we obtained some quarterly estimates of the gross industrial product of the Greek economy at 1970 constant prices (period 1963.I-1974.IV), taking into account all the available information (functional form, annual aggregates). These quarterly data have the advantage that aggregated over time with the time aggregation matrix C they give exactly the actual annual basis data.

We may extend the suggested time-disaggregation approach to estimate (disaggregate) the missing quarterly observations of the gross industrial product and other macroeconomic variables of the Greek economy using more flexible [13] distributed lag models.

Finally the suggested time disaggregation technique can be useful in the Greek National Statistical Service (Quarterly National Accounts Unit) to improve the quality of the published quarterly provisional data (Tserkezos, 1989a).

APPENDIX A

A Lagrangian [14] procedure for minimising (2.16) subject to (2.17) is used:

$$F_{\text{Lagr.}} = (y^m - x(\lambda)\, w)'\,(y^m - x(\lambda)\, w) - 2L'\,(Cy_1^{Q} - y_1^A) \qquad \text{(A.1)}$$

where L is a $(T_1/4)$ vector of the Lagrangian multipliers, with [15]

$$C = (I_{T_1/4} \otimes e_4') \qquad \text{(A.2)}$$

$$e_4 = (1, 1, 1, 1)' \qquad \text{(A.3)}$$

Differentiating (A.1) with respect to y_1^{Q}, setting equal to zero, after some algebraic manipulations we obtain the constrained equation:

$$y_1^{Q} - x_1^{Q}(\lambda)\, w - C'L = 0 \qquad \text{(A.4)}$$

Premultiply (A.4) by C and recalling that:

$$Cy_1^{Q} = y_1{}^A = C\bar{y}_1 \qquad \text{(A.5)}$$

[13] TSERKEZOS (1989a, pp. 5-25).

[14] For more, see: SARGAN-DRETTAKIS (1974, pp. 42-44), GILBERT (1977, pp. 225) and TSERKEZOS (1989a, pp. 374-75).

[15] $\otimes$ denotes the Kronecker product, for more see: HARVEY (1981a, pp. 358-59).

we may solve (A.4) for L to obtain:

$$L\,(CC')^{-1}\,C'\,(y_{Q} - x_{Q}(\lambda)\,w) \tag{A.6}$$

(A.6) substituted into (A.4) gives:

$$y_{Q} = x_{Q}(\lambda)\,w + C'\,(CC')^{-1}\,C y_{1Q} - C'\,(CC')^{-1}\,C x_{Q}(\lambda)\,w \tag{A.7}$$

Using the time-aggregation relations (2.20) and (2.21):

$$\bar{y}_1 = C'\,(CC')^{-1}\,C y_{Q} \quad \text{and} \quad \bar{x}_1(\lambda) = C'\,(CC')^{-1}\,C x_{Q}(\lambda)$$

the relation (A.7) can be written [16] as:

$$\hat{y}_{Q} = \bar{y}_1 + (x_{Q}(\lambda) - \bar{x}_1(\lambda))\,w \tag{A.8}$$

APPENDIX B

The Data

The data used in this study are annual and quarterly, seasonally-unadjusted observations on real 1970 prices. These were collected from the National Accounts (Annual and Quarterly) and the National Statistical Service of the Greek Ministry of National Economy and are defined as

$QVINDC_t$ = Quarterly gross product of the industrial sector of the Greek economy at 1970 constant prices over the period 1975.I, ..., 1987.IV.

$QPRIM_t$ = Quarterly index of industrial production, Branches 20-39 and base 1970 = 100 over the period 1963.I-1987.IV.

$AVINDC_t$ = Annual gross domestic product of the industrial sector at 1970 constant prices over the period 1963-1987.

These variables are given in Table 4.

The specification used to interrelate the under-time disaggregation variable $QVINDC_t$ (Gross Industrial Product) and the independent variable $QPRIM_t$ (Index of Industrial Production) was:

$$QVINDC_t = a + \sum_{j=0}^{00} b_j\,QPEIM_{t-j} + \sum_{j=1}^{4} (q_j + d_j\,TR_t)\,Q_{tj} + \gamma\,DUM73_t + u_t \tag{B.1}$$

$$t = 1963.\mathrm{I}, \ldots, 1987.\mathrm{IV}$$

with $\quad b_j = bv_j \quad v_j = (1-\lambda)\,\lambda^j, \quad \Sigma v_j = 1 \quad 0 < \lambda < 1$

and
$$DUM73_t = \begin{bmatrix} 0 & 1963.\mathrm{I}\text{-}1972.\mathrm{IV} \\ 1 & 1973.\mathrm{I}\text{-}1987.\mathrm{IV} \end{bmatrix}$$

---

[16] For more, see: GILBERT (1977), pp. 224) and TSERKEZOS (1989a, pp. 376).

TABLE 3

ESTIMATES OF SPECIFICATION (B.1) USING DIFFERENT ASSUMPTIONS ABOUT THE AVAILABLE QUARTERLY AND ANNUAL DATA

	Available Data		
	T = 1975.I-1987.IV $T_1 = 0$ T_2 = 1975.I-1987.IV	T = 1975.I-1987.IV T_1 = 1975.I-1978.IV T_2 = 1979.I-1987.IV	T = 1963.I-1987.IV T_1 = 1963.I-1974.IV T_2 = 1975.I-1987.IV
α	4.389342	3.488610	0.81438
	[2.6]	[2.4]	[2.5]
b	0.1577675	0.1635201	0.1936077
	[17.4]	[20.3]	[35.5]
λ	0.300000	0.33000	0.22000
	[n.c]	[n.c]	[n.c]
q_1	– 1.043762	– 0.967418	– 0.44022
	[3.4]	[3.2]	[2.6]
q_2	– 0.7613997	– 0.811447	– 0.494967
	[2.6]	[2.7]	[1.78]
q_3	– 0.514996	– 0.424701	– 0.146256
	[2.8]	[2.5]	[2.8]
γ	—	—	– 2.724905
			[2.3]
$\bar{R}^2$	0.9106534	0.91185946	0.98741063
$D.W.$	1.457	1.523	1.4335

[n.c] = non computed
[ ] = t-statistic
$\bar{R}2$ = Corrected squared coefficient of multiple correlation
$D.W.$ = Durbin-Watson statistic
All the computations were carried out using the Regression Analysis Time Series Program (RATS).

The estimates of the above specification [17] using different assumptions about the available quarterly and annual data are given in Table 3.

The relatively small estimated D.Ws of Table 3 indicates the existence of autocorrelation in the residuals of the model (first order autoregressive scheme). This is due to misspecification of the residuals of the model (2.1), but as we explained earlier, in Greece there are not many available time series in quarterly basis to be used as independent variables in specification (2.1).

[17] $DUM73_t$: Dummy variable to account for the constant term structural shift after the 1973 oil crisis.

APPENDIX C

TABLE 4

Gross Industrial Product * Billion Drachmae at 1970 prices			Index of Industrial Production 20-39 1970=100	Gross Industrial Product * Billion Drachmae at 1970 prices			Index of Industrial Production 20-39 1970=100
Time	Quarterly	Annual**	Quarterly	Time	Quarterly		Quarterly
1963: 1	8.58452		45.7333	1972: 1	23.3201		115.933
1963: 2	9.41297		52.1667	1972: 2	25.0495		126.867
1963: 3	11.4336		61.8333	1972: 3	26.1403		129.367
1963: 4	10.9469	(40.387)	55.5667	1972: 4	27.4450	(101.955)	135.867
1964: 1	9.94259		50.5000	1973: 1	26.2725		134.967
1964: 2	10.8830		58.1000	1973: 2	28.2758		148.133
1964: 3	13.0448		68.5333	1973: 3	29.9170		153.833
1964: 4	12.2766	(46.147)	60.2667	1973: 4	29.9018	(114.367)	151.100
1965: 1	11.2375		55.8333	1974: 1	25.8875		147.067
1965: 2	12.5787		65.9667	1974: 2	25.4590		145.500
1965: 3	14.0410		71.3667	1974: 3	24.8482		139.800
1965: 4	13.1890	(51.047)	63.4667	1974: 4	25.5132	(101.708)	144.367
1966: 1	11.4233		62.9667	1975: 1	25.6480		143.700
1966: 2	13.7710		78.8333	1075: 2	26.6310		149.633
1966: 3	14.8512		80.4667	1975: 3	27.0550		151.600
1966: 4	13.8255	(53.871)	71.9333	1975: 4	28.2020		157.233
1967: 1	12.9101		68.5667	1976: 1	27.5820		155.867
1967: 2	14.2895		78.8000	1976: 2	29.4370		166.367
1967: 3	15.0521		79.6333	1976: 3	29.2090		166.300
1967: 4	14.5824	(56.836)	75.1000	1976: 4	31.3720		176.967
1968: 1	14.5667		71.3333	1977: 1	29.2580		162.700
1968: 2	16.2967		83.7667	1977: 2	30.5170		165.333
1968: 3	17.6096		87.7000	1977: 3	30.9570		169.533
1968: 4	16.9660	(65.439)	81.3333	1977: 4	32.4920		177.733
1969: 1	16.9810		79.0000	1978: 1	31.5530		173.400
1969: 2	18.8468		92.0667	1978: 2	32.0240		180.667
1969: 3	19.4899		91.5000	1978: 3	32.4520		179.000
1969: 4	19.6209	(74.939)	91.0000	1978: 4	34.9420		193.900
1970: 1	18.3702		90.2667	1979: 1	33.5640		186.900
1970: 2	19.8309		100.200	1979: 2	35.1130		196.500
1970: 3	21.5546		107.133	1979: 3	34.5650		191.000
1970: 4	21.2203	(80.976)	102.233	1979: 4	35.6000		197.167
1971: 1	20.8229		99.6333	1980: 1	33.8560		190.567
1971: 2	22.0059		108.267	1980: 2	34.2680		198.533
1971: 3	24.2419		118.867	1980: 3	33.0570		191.767
1971: 4	23.7313	(98.802)	112.167	1980: 4	34.3050		197.667

* : Data in parentheses are the disaggregated quarterly observations of the Gross Industrial Product.
**: Actual Annual Data.
Source: Quarterly National Accounts and National Statistical Service of Greece (Ministry of National Economy).

TABLE 4 (*Continued*)

Gross Industrial Product * Billion Drachmae at 1970 prices			Index of Industrial Production Branches 20-39 1070 = 100
Time	Quarterly	Annual *	Quarterly
1981: 1	32.0810		182.067
1981: 2	33.1380		195.567
1981: 3	33.9380		192.600
1981: 4	34.2840		199.000
1982: 1	31.9060		184.733
1982: 2	32.4220		184.467
1982: 3	32.1570		173.567
1982: 4	33.9030		187.667
1983: 1	31.5220		178.033
1983: 2	31.8810		181.833
1983: 3	32.7870		178.967
1983: 4	34.4250		186.967
1984: 1	32.0930		180.900
1984: 2	32.6390		187.500
1984: 3	33.3870		180.600
1984: 4	34.0950		190.733
1985: 1	32.8340		175.733
1985: 2	33.4990		186.700
1985: 3	34.4530		191.433
1985: 4	36.2700		197.867
1986: 1	33.3570		181.567
1986: 2	34.4110		196.333
1986: 3	34.2580		187.017
1986: 4	35.2670		192.476
1987: 1	33.0970		171.928
1987: 2	33.6460		178.369
1987: 3	33.2250		181.619
1987: 4	34.9800		191.372

*: Data in parentheses are the disaggregated quarterly observations of the Gross Industrial Product.
**: Actual annual data.
Source: Quarterly National Accounts and National Statistical Service of Greece (Ministry of National Economy).

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DISAGGREGAZIONE TRIMESTRALE DEL PRODOTTO INDUSTRIALE LORDO GRECO ANNUALE CON L'USO DI SERIE COLLEGATE

Dati trimestrali sulle variabili macroeconomiche chiave dell'economia greca sono disponibili dopo il quarto trimestre 1974. In questo articolo si propone una tecnica per la disaggregazione temporale di queste variabili su base annuale fondata sulla tecnica dei dati "collegati mancanti". La metodologia applicata fornisce stime trimestrali del prodotto industriale lordo greco per il periodo 1963.I-1974.IV. I dati trimestrali disaggregati sommati risultano coerenti con i corrispondenti valori annuali.

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Il Consiglio Nazionale delle Ricerche ha contribuito alle spese di pubblicazione di questa rivista.

FONSPA BILANCIO 1992

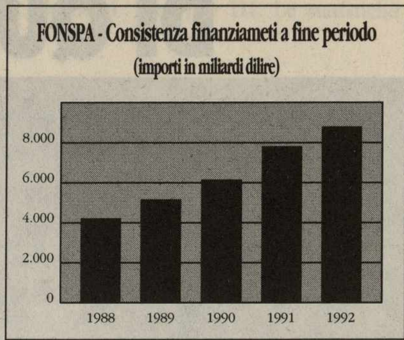
Si è tenuta a Roma, mercoledì 28 aprile, l'Assemblea ordinaria degli Azionisti del Credito Fondiario e Industriale - FONSPA (Gruppo IRI), che ha approvato il Bilancio chiuso al 31 dicembre 1992.

Nell'esercizio l'attività è stata soddisfacente pur in una fase caratterizzata da un progressivo deterioramento delle condizioni dell'economia sia nel mercato produttivo che in quello finanziario.

I nuovi finanziamenti sono stati pari a 2.402 miliardi (+5,7%), di cui 202,9 miliardi riferiti alla nuova attività di credito industriale iniziata ad aprile. A fine esercizio la consistenza degli impieghi ha raggiunto i 9.088,3 miliardi (+18,4%). Il margine lordo da mutui e impieghi è stato di 268,7 miliardi (+22,2%). L'incremento del margine netto è stato più contenuto (+8,4%) in relazione all'innalzamento dell'accantonamento al Fondo rischi da 0,3% a 0,4% degli impieghi.

L'utile netto, compreso quello della sezione Opere Pubbliche, assorbita alla fine del primo trimestre, risulta di 46,9 miliardi contro i 63 miliardi del precedente esercizio. Il decremento è conseguente alla crescita delle quote di ammortamento degli immobili (+4,7 miliardi), nonché all'indeducibilità dell'ILOR dall'imposta sul reddito (4 miliardi), alla nuova imposta sul patrimonio delle imprese (6 miliardi) e alla citata prudenziale politica degli accantonamenti (+10,2 miliardi).

Verrà distribuito un dividendo di 200 lire per azione, uguale a quello dell'anno scorso, oltre, ai sensi del secondo comma dell'art. 2357 ter c.c., la quota afferente le azioni proprie eventualmente ancora in proprietà al 17 maggio 1993. Giorno in cui lo stesso verrà messo in pagamento, su presentazione dei certificati azionari, ai sensi delle disposizioni di legge, presso la Banca Commerciale Italiana, il Credito Italiano e le altre consuete Casse incaricate, nonché presso la Monte Titoli Spa (per i titoli dalla stessa amministrati) e la Sede sociale dell'Istituto. A seguito del rinnovo per decorrenza triennale, il Consiglio di amministrazione nominato dall'Assemblea ha eletto alla carica di Presidente Mario Piovano ed a quella di Vice Presidente Oliviero Prunas. Direttore Generale è Antonio Masala.



La documentazione di cui alla deliberazione CONSOB n. 5553 del 14.11.1991 è depositata presso la Sede sociale in Via C. Colombo, 80 e presso il Consiglio di Borsa sedi di Milano e Roma. Copia della stessa verrà inviata a chiunque ne faccia richiesta.

	1991	1992	VAR %
Impieghi.	7.677,6	9.088,3	+18,4
Margine lordo	220,0	268,7	+22,2
Margine netto	150,3	162,9	+ 8,4
Fondi propri	1.074,6	1.136,1	+ 5,7

FON SPA CREDITO FONDIARIO E INDUSTRIALE S.p.A.

ISTITUTO PER I FINANZIAMENTI A MEDIO E LUNGO TERMINE

L'INTRAPRENDENZA PRENDE FORMA

ISTITUTO CENTRALE DELLE BANCHE POPOLARI ITALIANE

SOCIETÀ PER AZIONI

CAPITALE SOCIALE E RISERVE AL 31 DICEMBRE 1992: L. 281.123.214.845

Direzione Generale: MILANO - Corso Europa, 18

Ufficio di Roma e Sede Sociale: ROMA - Via Donizetti, 12/a - 14

Tribunale di Roma: Registro società n. 526/41 - Fascicolo 598/41
Anno di Fondazione: 1939

BILANCIO 1992 (lire miliardi)

ATTIVO		PASSIVO	
Corrispondenti debitori e fondi presso l'Istituto di Emissione	1.781,5	Corrispondenti creditori e assegni circolari	2.685,6
Titoli di proprietà	834,6	Fondi rischi, assistenza Banche popolari e accantonamenti	55,5
Partecipazioni	165,9	Ammortamenti	14,9
Crediti verso l'Erario	92,3	Voci diverse	34,2
Immobili	71,7	Capitale sociale e riserve	281,1
Mobili e impianti	5,3	Utile netto	6,3
Voci diverse	126,3		
	3.077,6		3.077,6
Conti impegni, rischi e d'ordine	71.427,8	Conti impegni, rischi e d'ordine	71.427,8
	74.505,4		74.505,4

L'8 maggio 1993 ha avuto luogo in Roma, presso la sede sociale dell'Istituto, l'assemblea ordinaria degli Organismi associati (Banche Popolari ed Istituzioni della Categoria) che ha approvato il bilancio dell'esercizio 1992.

Dopo ammortamenti, svalutazioni titoli, accantonamenti ai fondi rischi ed assegnazione di L. 8,5 miliardi alla « Riserva disponibile », è stata deliberata la seguente ripartizione dell'utile netto di L. 6,3 miliardi:
– distribuzione di un dividendo di L. 125 alle n. 8.287.060 azioni da nominali L. 500 cadauna costituenti il capitale sociale;
– attribuzione alla « Riserva legale » di L. 4,5 miliardi, per aumentarla a L. 42 miliardi;
– ulteriori assegnazioni, ivi compresa la destinazione di una quota ad incremento del « Fondo assistenza Banche Popolari ».

Nel corso dell'assemblea si è trattato anche dell'attività esplicata, durante l'anno 1992, dalle tre principali società al cui capitale partecipa l'Istituto, società che per la rilevanza delle quote partecipative possedute rientrano tra le « collegate » (CENTROSIM, ITALFONDIARIO, SECETI).

Gli organi sociali dell'Istpopolbanche, dopo le nomine deliberate l'8 maggio 1993, risultano così composti:

CONSIGLIO DI AMMINISTRAZIONE

Presidente: Gr. Uff. Rag. Carlo PAVESI; Vice Presidenti: Dott. Italo Giorgio BOCCI - Comm. Rag. Giovanbattista FIORENTINI; Consiglieri: Gr. Uff. Dott. Rag. Vittorio AULENTI - Cav. Gr. Cr. Uff. Dott. Rag. Giuseppe Antonio BANFI - Dott. Paolo BORELLI - Dott. Cesare CALETTI - Comm. Dott. Giovanni CARTIA - Gr. Uff. Dott. Antonio CEOLA - Avv. Pier Luigi COLIZZI - Comm. Rag. Giovanni DE CENSI - Gr. Uff. Rag. Giandomenico DI SANTE - Gr. Uff. Rag. Edoardo FANI - Comm. Dott. Josef FROSCHMAYR - Avv. Giuseppe IMPERATORI - Marchese Dott. Franco LUCIFERO - Cav. Prof. Dott. Renato MASTROSTEFANO - Comm. Dott. Angelo MAZZA - Avv. Vincenzo MERLINO - Gr. Uff. Dott. Vincenzo MOSCA - Comm. Pietro NIADA - Dott. Piermaria PACCHIONI - Cav. Gr. Cr. Dott. Giuseppe PEDRONI - Gr. Uff. Prof. Dott. Federico PEPE - Cav. Gr. Cr. Prof. Avv. Piero SCHLESINGER - Cav. del Lav. Gr. Cr. Rag. Lino VENINI - Comm. Dott. Giuseppe VIGORELLI. Segretario del Consiglio: Dott. Franco DE MAJO.

COLLEGIO SINDACALE

Presidente: Comm. Rag. Ottavio FONTANESI; Sindaci effettivi: Comm. Rag. Pietro AGNOLUZZI - Dott. Domenico MONTOSCHI - Rag. Adriano MORA - Cav. del Lav. Dott. Matteo PITANZA; Sindaci supplenti: Cav. Rag. Armando BENEDETTI - Comm. Dott. Antonio CITARELLA.

DIREZIONE GENERALE

Direttore Generale: Dott. Franco DE MAJO; Vice Direttore Generale: Dott. Luciano BRUSAFERRI.

ISTITUTO CENTRALE DI BANCHE E BANCHIERI

Sede Sociale e Direzione Generale: Milano, Corso Monforte, 34

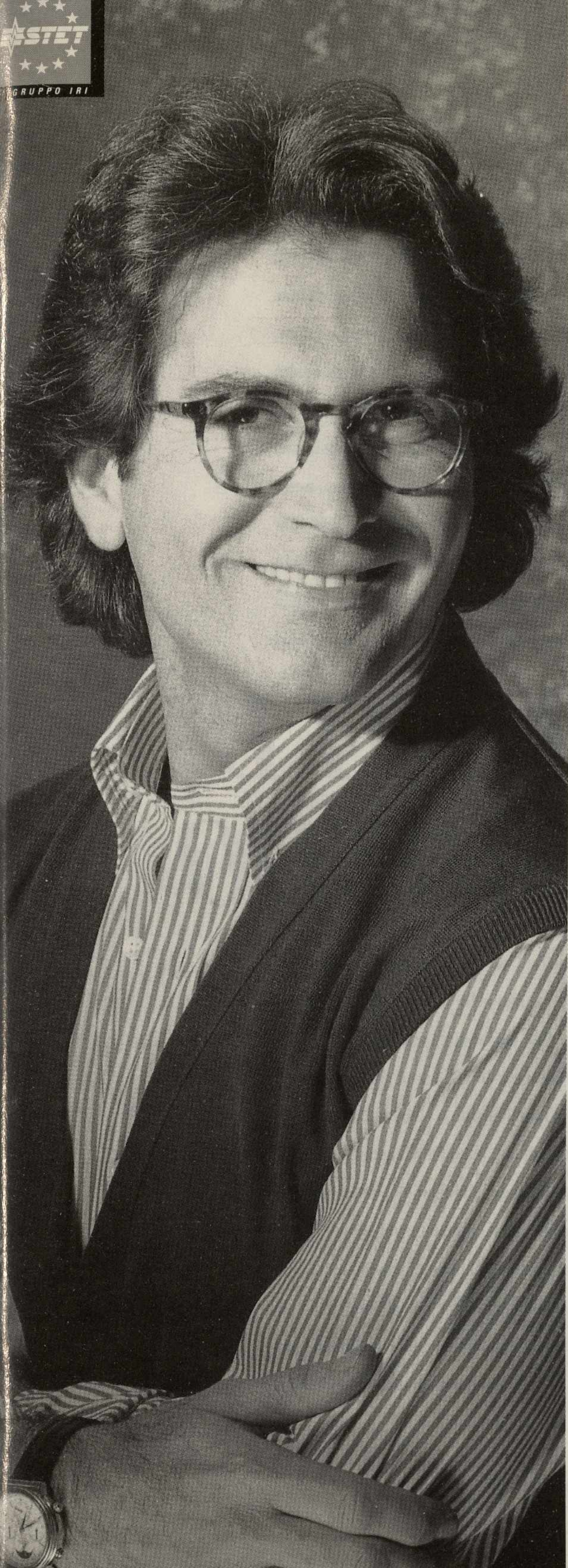
BILANCIO AL 31 DICEMBRE 1992

ATTIVO

	Lire	Lire
Cassa		2.313.784.688
Depositi e conti correnti con istituzioni creditizie:		
– controllate	20.440.251.003	
– altre	2.800.734.080.068	
		2.821.174.331.071
Finanziamenti ad istituzioni creditizie		10.000.000.000
Titoli di proprietà		967.584.500.242
Partecipazioni		139.767.422.579
Crediti verso clienti:		
– società controllate	35.550.868.982	
– altri	339.513.028.669	
		375.063.897.651
Crediti verso l'erario		26.667.843.745
Altri crediti		412.680.901.844
Immobili		151.536.403.358
Impianti e macchine		8.761.661.987
Mobili e arredi		4.200.346.950
Costi pluriennali		1.064.814.291
Ratei attivi		73.119.529.726
Risconti attivi		303.309.588
Totale dell'attivo		**4.994.238.747.720**
Conti impegni e rischi		5.063.101.962.964
Conti d'ordine:		
– Depositari titoli	7.347.271.004.058	
– Titoli e valori in deposito a cauzione	353.864.910.000	
– Titoli e valori in deposito a garanzia	109.366.017.788	
– Titoli e valori in deposito a custodia	6.651.108.863.661	
– Depositari moduli assegni circolari in bianco	19.797.345.000.000	
		34.258.955.795.507
Totale generale		**44.316.296.506.191**

PASSIVO

	Lire	Lire
Depositi e conti correnti di istituzioni creditizie:		
– controllate	109.000.282.884	
– altre	3.920.881.883.670	
		4.029.882.166.554
Certificati di deposito interbancari		66.000.000.000
Finanziamenti ricevuti da istituzioni creditizie		15.408.423.221
Depositi e conti correnti di clienti:		
– società controllate	3.028.389.407	
– società collegate	11.965.623.609	
– altri	66.431.430.912	
		81.425.443.928
Assegni circolari		168.372.021.450
Debiti verso l'erario		1.179.099.714
Altri debiti		99.619.445.105
Ratei passivi		80.686.227.372
Risconti passivi		722.043.365
Imposta sostit. *ex* L. 408/90		4.428.807.821
Imposta sostit. *ex* L. 413/91		878.572.216
Fondo imposte e tasse		17.025.982.761
Fondo trattamento di fine rapporto del personale		5.153.641.351
Fondi di ammortamento:		
– Immobili	25.296.947.715	
– Impianti e macchine	7.659.358.643	
– Mobili e arredi	2.702.657.421	
		35.658.963.779
Fondo rischi su crediti		18.215.000.000
Riserva acquisto azioni proprie		1.970.355.952
Fondo oscillazione valori		150.000.000
Patrimonio:		
– Capitale sociale	86.738.730.000	
– Riserva legale	49.010.199.915	
– Riserva straordinaria	87.275.463.212	
– Riserva speciale	8.170.180.000	
– Riserva rivalutazione monetaria L. 1983/72	8.800.000.000	
– Fondo acquisto azioni proprie	1.529.644.048	
– Fondo plusvalenze L. 1983/169	2.942.787.327	
– Fondo per rischi bancari generali	6.549.370.495	
– Avanzo di fusione Immist	8.693.837.490	
– Avanzo di fusione S.P.B.	7.448.070.000	
– Fondo sovrapprezzo azioni	5.000.000.000	
– Sovrapprezzo azioni S.P.B.	1.596.015.000	
– Riserva Rivalutazione *ex* L. 408/90	55.360.101.351	
– Riserva Rivalutazione *ex* L. 413/91	19.218.754.884	
– Riserva *ex* L. 218/90	6.915.272.647	
		355.248.426.369
Utile dell'esercizio		12.214.126.762
Totale del passivo e del patrimonio		**4.994.238.747.720**
Conti impegni e rischi		5.063.101.962.964
Conti d'ordine:		
– Titoli presso terzi	7.347.271.004.058	
– Depositanti titoli e valori a cauzione	353.864.910.000	
– Depositanti titoli e valori a garanzia	109.366.017.788	
– Depositanti titoli e valori a custodia	6.651.108.863.661	
– Moduli assegni circolari in bianco presso terzi	19.797.345.000.000	
		34.258.955.795.507
Totale generale		**44.316.296.506.191**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